ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. LIII. No. 13 — NEW YORK, SATURDAY, SEPTEMBER 26, 1908. — ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . VICE-PRESIDENT
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

NEW YORK
PUBLISHING OFFICE . . . . . 13-21 PARK ROW
CHICAGO
WESTERN OFFICE . . . . . FISHER BUILDING
BOSTON
NEW ENGLAND OFFICE . . . . . 95 MILK STREET
LONDON
EUROPEAN OFFICE, HENRY W. HALL, Manager, 42 OLD BROAD STREET, E. C.

TELEPHONE AND CABLE
TELEPHONE "21 Cortland." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

SUBSCRIPTIONS
One Year, United States $3.00
One Year, Canada 4.00
One Year, Foreign Countries 6.00
Single Copy, 10 cents Back numbers, beyond one month, each . . .25

ADVERTISING
CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.
NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

Published weekly by the ELECTRICAL REVIEW PUBLISHING COMPANY, 13 Park Row, New York. Charles W. Price, president and treasurer; Stephen H. Goddard, vice-president; H. S. Tuthill, secretary.

Entered at the Post Office at New York as second-class matter under the Act of March 3, 1879.

CONTENTS

EDITORIAL:
The Evolution of the Laws of Thermodynamics . . . 457
A New Departure in Illuminating Engineering . . . 458
Destruction of the Paris Central Telephone Exchange . . . 459
Commercialism . . . 459
Vermont Electrical Association . . . 460
The Association of Edison Illuminating Companies . . . 463
Meeting of Railway Commissioners . . . 463
Pittsburg Section, American Institute of Electrical Engineers . . . 463
American Society of Mechanical Engineers . . . 464
Large Water-Power Development on the Mississippi River . . . 464
The Convention of the American Street and Interurban Railway Association . . . 464
Canadian Bell Telephone Company Extending Its System . . . 465
Modern Science Club . . . 465
Memorial to Alexander Graham Bell . . . 465
The October Meeting of the American Institute of Electrical Engineers . . . 465
National Electric Lamp Association to Establish a Department of Physical Research . . . 465
The British Association Meeting . . . 466
Electrification Plans of the Delaware, Lackawanna & Western . . . 466
New York Edison-Philadelphia Electric Outing . . . 466
Illinois Central Electrification . . . 466
New Wireless Test . . . 466
A Unique Water-Power Plant, by H. Lester Hamilton . . . 467
Electrical Equipment for the Santos Dock Company, Brazil . . . 469
The Kokomo, Marion & Western Traction Company, by C. A. Tupper . . . 469
Dark Spots with Alternating-Current Moving-Picture Machines . . . 472
The Discovery and Development of the Laws of Thermodynamics—I, by Dugald Clerk . . . 472
Financial Reports of Electrical Companies . . . 477
Steam Turbines in Power Stations . . . 477
Georgia and Florida Independent Telephone Companies . . . 477
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE . . . 478
INDUSTRIAL SECTION:
A Notable Sirocco Fan Installation . . . 480
Electrical Cleaning . . . 480
Speed Counters . . . 481
Drill Grinding by Machinery . . . 481
Milling Machine . . . 482
Famatina Development Corporation . . . 482
New German Cable Company . . . 482
A Heavy Wire Lamp Guard . . . 483
A Thoroughly Insulated Lamp Guard . . . 483
First Annual Report, Public Service Commission, Second District, State of New York . . . 483
The Kansas Gas, Water, Electric Light and Street Railway Association . . . 483
CURRENT ELECTRICAL NEWS . . . 484
RECORD OF ELECTRICAL PATENTS . . . 489

Copyright, 1908, by Electrical Review Publishing Co.

THE EVOLUTION OF THE LAWS OF THERMODYNAMICS.

For his presidential address before the engineering section of the British Association for the Advancement of Science, which held forth recently in Dublin, Ireland, Mr. Dugald Clerk took the subject of the discovery and evolution of the laws of thermodynamics. The address is entirely historical in nature, but there runs all through it a philosophical interlude which adds to the recapitulation the charm of easy reading and affords a most satisfactory method of reviewing our knowledge of a subject dear to the heart and mind of all engineers. The story is romantic, too, and we can live over some of the struggles and gratifications which came to those sturdy workers who have done so much to place our scientific knowledge on a firm footing.

It seems almost absurd, however, in the light of our present knowledge and our superficial scanning of text-book information, that these discoveries were made only at such an expenditure of mental and physical effort. Notwithstanding the fact that steam-engine development had reached a very satisfactory stage, it was not until 1849 that Carnot evolved his famous theory of the functions of a perfect heat medium; and, even at that time, Carnot was very much in the wrong in not a few of his assumptions. With Dugald Clerk we go over the ponderings of Joule and Thomson, and we can see the latter, a young man of mighty intellect, becoming impressed with Joule's announcement and calling to the attention of those who very coolly received these statements their importance and the great field of opportunity that they opened up. We can almost realize a psychological emotion at the joining together of these two intellectual forces, and we can only wonder, in the light of the subsequent achievements of these great minds, that they did not arrive earlier at their splendid conclusions. And, reading further, we are struck with amazement at the tenacity with which other brilliant minds clung to opinions which were finally overcome and rendered obsolete by later investigations and discoveries.

This brings to mind at the present day the thought of the work which is now engaging the attention of some of our greatest intellects in the fields of wireless communication and the various phenomena connected with the study of radioactive forces. Surely it seems that the study of these forces requires a knowledge and an intellect and an ability for abstract reasoning the like of which did not exist in the problems connected with the laws of thermodynamics. Will culture have advanced to such an extent fifty years hence that students, poring over

their text-books, will wonder why Becquerel and Hertz, the Curies and Kelvin, Fessenden and Stone, Roos and Pickard, Marconi and De Forest, did not arrive at definite conclusions concerning the phenomena with which they were dealing with less expenditure of effort? Will it then seem that these things should have been more readily understood, or are we becoming bankrupt of intellectual and scientific resources, as was pointed out a decade ago—before Hertz and others of his scientific stature enunciated their wonderful theories concerning the ion and the atom of electricity?

When we realize the marvelous accumulation of information with which we have garnished our intellectual storehouses and read the history of this advance, we are impressed with the fact that for each problem there has been developed a mind sufficiently great to solve it, and we must feel that, even though at times the riddle of the universe seems imponderable, we shall still ascend peak after peak of learning and some day arrive, not at the stars, but sufficiently near to realize that they and we are made of the same clay.

A NEW DEPARTURE IN ILLUMINATING ENGINEERING.

Within the last few years many central stations have realized that a field exists for the better use of illumination on the premises of certain customers, and in an informal way some of the more progressive companies have from time to time gone out of their way to offer suggestions leading to improvement. The most notable step in this direction that has thus far been taken is the action of the Boston Edison Company in opening a special department of illuminating engineering on September 1 at its main offices. This new branch of the company's work will afford free consultation on the application of electricity to lighting problems for any of its customers who will take the trouble to call upon or send for the expert advice which is now at their disposal. The company believes that in helping its customers to use electricity most efficiently it is creating a satisfied clientele which is a most valuable asset, and while in many cases the recommendations of the department will mean a reduction in the monthly bills of customers applying for advice, the fact that the prosperity of the company is intimately related to the prosperity of its clients will in the long run work out to the general advantage of all concerned.

For any public-service corporation to voluntarily take steps which may reduce a portion of its immediate income requires a broad and courageous view of the business situation, and not a little faith in the intelligent appreciation of its customers of efforts to serve them well. In the last twenty-two years the average cost of electricity to Boston Edison customers has been reduced seventy-five per cent. The average dwelling and office cost has been cut fifty-eight per cent; stores, eighty-three per cent, and long-hour burners, eighty-seven per cent. Within the last two years the average cost has been reduced forty per cent. The company has taken from the first an advanced and progressive position regarding the tungsten lamp and other high-efficiency units, and in starting the new department it is expected that the immediate effect of the recommendations will be to create general satisfaction with the policy of showing customers how to get the most and the best light for their money. The numerous inquiries immediately received after the opening of the department was announced show conclusively that the Edison company's customers in Boston and its vicinity are thoroughly alive to the merits of a proposition of this character, and it is expected that some remarkably interesting data will be accumulated within the next few months. We do not know whether the company formally intends to handle the power business in a similar way, but if the work of the illuminating division should be of a permanent character, it would be a logical step to carry the same idea into the motor field. To a large extent, of course, all progressive companies are glad to advise their customers as to the use of power, but the handling of such problems by a special branch of the central station organization affords a more systematic method of dealing with these semi-technical questions.

That there is room for a great deal of improvement in both electric lighting and power applications can not be doubted by any one whose opportunities for observation cover a large part of this country. One of the reasons for this condition is the lack of the proper advice when the original installation is made, and another is the inadequate handling of the statistical end of the power and lighting problem by some of the central station organizations. All new and revised electrical installations call for more or less real engineering skill, and in many instances the purchaser has been entirely unwilling to pay for the advice of an experienced engineer in selecting his apparatus and its method of application to his peculiar conditions. The result has been that while many electric power installations are more efficient than the steam or other mechanical transmissions that preceded them, the bills are actually higher than would be the case if a skilled engineer had been given the chance in the first place to carefully study the conditions. Again, central stations are notoriously deficient in the filing of complete data of their power and lighting installations, so that when the commercial departments undertake to secure new business, many problems have to be figured without the advantage of referring quickly to the detailed facts. The costs of the installation may be filed with some care, but the particulars of the mechanical drive, speed ranges, normal and overload capacities are apt to be lacking. In the lighting field the same paucity of accurate data is notable. A company may have a complete list of all the mercantile houses, for instance, which have adopted the tungsten lamp in place of the gas arc, but it will be unusual if its files contain any particulars of the installation in the line of room sizes, wall colors and height of installed lamps above the floor. It is not enough to tabulate the number of lamps replaced in each case. In a recent trip through about a dozen states in search of central station power data, only one company was found

which had the details of the pulley sizes in its possession, in connection with its applications of motor driving.

These conditions will inevitably be remedied if the central stations find it profitable to take up and continue the advising of their customers along the lines started in Boston, and in cases where an outside engineer would clearly never be called in there is no doubt that much good may be expected from such a policy. Experience alone will tell just where the central station should cease to advise its customers and where the consulting engineer should step in. Presumably the time is scarcely ripe as yet for highly successful independent practice in the minor problems of illuminating engineering, and in the smaller power applications the cost of expert consulting advice from other sources than the central station or manufacturer's staff is clearly prohibitive. In a general way it would seem that when the work is of sufficient magnitude to require the making of plans and specifications by an outside party, the central station should stand aside, furnishing its advice freely as before, but refraining from entering distinctly upon the consulting field through the preparation of costly drawings, the writing of specifications and the supervision of construction. There is clearly a limit to the wise expenditures of a central station for advising its customers, but time alone will show where this limit falls.

DESTRUCTION OF THE PARIS CENTRAL TELEPHONE EXCHANGE.

Despatches from Paris state that on September 20 a disastrous fire destroyed the central telephone building and a portion of the post-office at the French capital. It is estimated that the loss will approximate $6,000,000. This is, however, the estimate for only the material loss, as no approximation can be made of the loss incident to the prostration of business and the anxiety and mishaps which ensued from the tying-up for even a short time of the arteries of communication of a great cosmopolitan centre. Not only was telephonic communication suspended, but the outbound telegraph systems were also put temporarily out of commission. Heroic work under the direction of the under secretary of posts and telegraphs soon re-established telephonic communication with London and Brussels from the Bourse and the post-office. Arrangements are being made to set up a provisional exchange to take care of commercial communication.

For a long time the telephonic situation in Paris has been anything but satisfactory. Only recently we had occasion to review an article by the president of the Paris association for the improvement of the telephone service, in which it was emphatically deplored that the government was entirely incompetent to cope with the necessities of the situation, and advocating the turning over of the system to a private concern. Many leading business men of Paris hold the opinion that it is only by enlisting private capital in the enterprise that the vast amount of money needed to rehabilitate the system can be procured, as the government appropriation is entirely too small, and the inertia of the government organization will not allow the present generation of business men in Paris to secure the advantages of a modern system. It is deplorable indeed that Paris is thus so suddenly deprived of its telephonic communication, because, bad as the service may have been, it certainly was a great improvement over no service at all. Now, however, that an accident has made it necessary for actual and material rehabilitation, it would be well for the government to give ear to the protests of those who need and use the telephone, and encourage the installation of a modern system built and operated, if need be, entirely by private capital.

COMMERCIALISM.

The convention of the Vermont Electrical Association, held at Bennington last week, was devoted mainly to a discussion of the commercial side of public utility work, the technical, or engineering, features of central station service being referred to only incidentally. The keynote of the situation was sounded in the presidential address, when it was declared that the technical problems had been pretty well solved, and that there was nothing essentially new to be discussed at the present time. Matters of public policy, of increasing the number of new customers and retaining those already on the books of the company, were to-day of prime importance to the central station manager. One of the speakers, a copious abstract of whose remarks appears on another page, made the bold statement that five years hence the engineering features would be incidental to what will then be regarded as a purely commercial proposition of manufacturing and selling a necessary commodity. Mr. Rae's remarks in some directions are radical, and the sting will go deep and possibly hurt a good deal; but they should not be taken so much as an attempt to teach one one's business as they should be regarded as the effort of the specialist to indicate possible lines along which special work may be conducted. The men who are to-day foremost in developing plans for increasing the sale of current are not claiming to know much, if anything, about the engineering features of central station work, but they do believe that they know how to sell a product once it is available for the market.

Now, we must realize that there is plenty of opportunity for each to help the other. The engineer will devote his attention to making his station safe, his transmission system reliable, and to producing electricity at the lowest possible cost consistent with reliability. On the other hand, the executive department will unceasingly direct its efforts toward increasing the market for its product by, first of all, insisting that the public shall know that it is in business the same as any other manufacturer, that its product is tangible and is subject to the same laws as any other manufactured product, and, while encouraging a monopoly of this service, indicate the same regard for its patrons as exists when there is the most open-handed and free-for-all competition.

Vermont Electrical Association.

Seventh Annual Convention, Held at Bennington, Vt., September 16 and 17.

THE seventh annual convention of the Vermont Electrical Association, held in Bennington, Vt., September 16 and 17, was unique in several respects. There were only three numbers on the programme, and all of these were purely commercial. The fact is significant. "We feel that the technical problems are pretty well solved and not especially new," said President E. E. Larrabee in opening the meetings, "but the commercial questions are always new and we never tire of talking of how to get more new business without losing any of the old, how to create demands for current-consuming devices and how to make the use of electricity a necessity instead of a luxury."

The programme as announced was made up of papers by H. C. Rice, of Cleveland, Ohio, on "The Tungsten Lamp and Its Effect Upon the Smaller Central Station"; by Frank B. Rae, Jr., and George Williams, of New York, on "Commercialism"; by Henry L. Doherty, of New York, on "Public Service Corporations." Owing to a misunderstanding Mr. Doherty was unable to be present, but the association was fortunate in filling his place with an address on "State and National Electric Light Associations," by T. Commerford Martin, of New York. Glenn Marston, of New York, also spoke on "Public Policy."

About 100 members and guests were present in the meeting room when President Larrabee called the convention to order.

Harry C. Rice followed with his paper on tungsten lamps, which combined a brief sketch of the technicalities of lamp making with much practical advice on the commercial aspects of high-efficiency units. In describing tungsten lamps, Mr. Rice showed specimens of the ore from which the metal tungsten is reduced, together with samples of crude and refined tungstic oxid, pure tungsten in powdered form and finished filaments. He then launched into the commercial questions involved in the selling and renewing of these lamps, covering the subject at length.

Comparisons were made between the tungsten lamp and the flaming arc, gas arc, gas burner, Nernst lamp and various incandescent units, and arguments adduced to prove that there is no reason to fear the tungsten; rather that central station men should take the initiative and offer the new lamps rather than wait until they are driven into this field of lighting.

In the discussion that followed many valuable points were brought out. H. W. Brown, of the General Electric Company, pointed out the difficulties and percentage of loss in manufacture and stated that as the lamps come into more general use the price will gradually decrease. Their present high cost, he said, precluded free renewals, but this was really an advantage as it served to educate the public away from the free renewal and made them appreciate the economy of high-efficiency units. Mr. Brown also talked at some length on the monthly rental plan which is being tried in various localities. At Lowell, Mass., a flat rate of twenty-five cents per lamp per month is charged for tungsten renewals; at Elkhart, Ind., the rate is twenty-four cents for a forty-watt lamp, twenty-seven cents for a sixty-watt lamp and thirty cents for a 100-watt lamp. The plan, he said, was proving successful.

Samples of the twenty-five-watt tungsten lamp were exhibited and led to considerable discussion as to their effect. The feeling was expressed by several of those present that both this and the 250-watt size can hardly be considered as commercially available, though numbers have been installed in practical service with satisfactory results. The city of Hartford, Ct., Mr. Brown said, is about to install 250-watt tungstens for street lighting in order to secure data on results. Mr. Larrabee stated that where a plant is loaded to its capacity, the tungsten lamp offers a means of saving investment in new generators and enables the lighting man to secure the same income from customers with longer hours of burning.

The discussion of Mr. Rice's paper occupied the entire afternoon session.

The evening session was held in the rooms of the Bennington Club and was attended by a number of the leading business and professional men of the city. The first item on the programme was Mr. Rae's paper on "Commercialism," in part as follows:

Five years ago commercial engineering in the central station field was the doubtful side line of a technical business. Five years hence electrical engineering will be only incidental to what will then be an almost purely commercial enterprise.

Five years ago, also, the lighting company was—in the public mind—a monopoly, a slimy serpent of graft and grab, proceeding by devious and subterranean ways, debauching city officials, pre-empting public lands and franchises and robbing the widow and orphan. Five years hence it will be recognized generally that the central station is nothing more or less than a manufacturer and retailer of a necessary commodity.

The reason for these changes may be summed up in one word—commercialism.

DEFINITION.

Central station commercialism is even yet vaguely understood. To many managers of lighting plants it means little more than a spasm of hysterical advertising. To others it means such advertising plus a season of brazen solicitation by underpaid canvassers. But to a few, perhaps one per cent of the central station managers of the country, it means the wise conduct of business along business lines, unhampered on the one side by too narrow engineering ethics or upon the other by political intrigue or financial jugglery.

It embraces—I name them in the order of their importance—public policy, general management, soliciting, advertising.

Let me define these briefly.

PUBLIC POLICY.

Public policy means the company's attitude and policy toward the public. One point may well be remembered, however: public policy is not something to resolve about in board meetings and spread upon the records; it is the mainspring of daily routine. It applies not only to public officials, newspapers and important customers, but to the ignorant foreigner who kicks about his minimum bill. It applies whether you have indigestion or not; it must be maintained unchanged in the face of any accident to plant or lines; it must be followed by every man in the organization every hour of the day.

GENERAL MANAGEMENT.

General management means what it says—general management. It is part of commercialism—the most important part.

The organization of a central station personnel parallels closely the layout of the plant and system. The board of directors is the prime mover. The general manager is the generator; the engineers, linemen, office force and solicitors are the apparatus energized, all doing a variety of work over a large or small territory,

but all getting their impetus from one source. And just as the generator in your plant does not actually perform the work of the motors on the lines, so the real general manager does not do the work of his employés. It is commendable to be able to strap on a pair of climbers, shin up a pole and demonstrate to some mutton-headed lineman the right way to do his work—but it is poor management. A good manager would not have that kind of a lineman.

This holds in all departments. The manager draws his pay for managing, not for being every employé's superior in every branch of central station work. Successful management requires a certain amount of physical and mental leisure in which to ponder and plan. The man who clutters his brain with the detail of non-essentials will be unable to give clear-sighted, unhurried consideration to those larger problems which daily confront him. Of these problems nine out of ten are commercial.

THE COMMERCIAL CAMPAIGN.

First of these problems is the main plan of the commercial campaign; there must be one, whether or not a company employs solicitors and advertises. Just as one would not build a power-house without first sketching it out on paper, so there can be no commercial success without some sort of prearrangement. Without it you would only putter.

Right here too many managers err. They confound a business-getting scheme with a commercial plan. They hit upon some such detail as the installing of signs on flat rates or of loaning tungsten fixtures and renewing the lamps for a set sum per month. Those are schemes, not plans.

A commercial plan is a broad policy of commercial advancement based upon the daily load-curve, the condition of the company treasury, the status of the company's securities, local business and political conditions and the manager's ability as an organizer and executive. Such a plan has its foundation on the bed rock and its purpose is a commercial structure which shall endure indefinitely. (And here let me say parenthetically that makeshifts are the curse of America, and the manager who knowingly is content with a makeshift commercial plan writes himself down as a sloven or a fool. Happily, most such mistakes are the result of shortened perspective.)

The petty detail of the day is so close to the eye and looms so large that one can scarcely see it in its true relationship to the larger scheme of things. Like the boy in the fable, there are so many trees we can not see the forest. But if we recognize the difficulty its correction is easy.

Having sketched your main commercial plan—one that is broad, solidly grounded, yet flexible enough to allow for technical, political or business developments—it will be found that the various business-getting schemes, devices and methods will take their proper places. There is an abundance of such schemes, all good when adapted to local conditions. Their danger lies in the tendency to *adopt* rather than to *adapt*. No two sets of local conditions are identical, and no two central station organizations are the same. The electrical fraternity is fortunate in that it is common practice to interchange ideas and experiences, but when this intercourse results in the method of one manager being copied exactly and slavishly by another, without regard to the dozens of peculiar conditions surrounding each, it is a decided disadvantage. Do not think from this that I advocate nothing but new and original schemes. The company that relies wholly upon the brains within its organization will have a hard time. Gather ideas where you will—from the trade press, the manufacturer's salesman, the experience of other industries, from your fellow managers—take them where you find them, but make them your own. Fit them to your needs—adapt them to your organization—trim and cut or expand and enlarge them to meet your local conditions.

SOLICITING.

When it comes to the actual soliciting of a contract, adapt again your scheme to the specific case in hand. Make it fit not only your own requirements, organization and local conditions, but the particular needs and individual characteristics of the man whom you solicit. This is important. Too many companies adopt an idea and then try to force it, willy-nilly, down the throats of their clients. It is a vain and saddening experience. Despite your best arguments to the contrary, the average business man will persist in believing that he knows something about his own affairs. Nine men in ten will rebel at the cut-and-dry scheme, the standard and uniform "free sign," the ready-to-wear window lighting or store equipment. By all means have a general scheme, but make it flexible; allow for the idiosyncrasy (or idiocy, if you prefer) of the individual customer.

And give your solicitors a chance to use that flexibility. At the risk of being guilty of bragging, I may say that I sell sixty per cent of the men I call on. This is not the result of crafty salesmanship or superior intellect. It is because I never see a man with a sales proposition that has not been carefully adjusted to fit his needs and give him results. All his objections are provided for and refuted in advance. Not only that; the made-to-measure proposition is something which he can and will endorse immediately, enthuse over and insist upon with the least possible delay. The central station salesman can do the same. He knows—or should know—every customer in advance. He knows that man's business, rating, character, possibilities, prejudices. What easier, then, than to fit the scheme to the man, instead of trying to stretch or compress every man to a stock scheme?

A trouble experienced by too many lighting companies is that they get results from only a very small percentage of their salesmen's calls. This is not always the salesman's fault; generally it is because they either insist upon too many calls or seem to the salesman to demand too great immediate results. And the salesman, hurrying from door to door like a book agent the last week before Christmas, neither prepares his way in advance nor leaves a friendly opening for a call back.

In guiding salesmen, give them a little head, counsel them to patience and careful preparation, rehearse with them the day's campaign. Then, when a critical moment comes, swing every ounce of weight, every breath of influence, to the aid of the man with the order book. And when he has won, be free with the praise that heartens him for the next conquest. The great mistake in this field consists in dubbing our salesmen "solicitors" and in looking upon them as a species of business-getter but one removed from the book agent—poorly paid, delegated with no authority, supported only when convenient. If you hire salesmen, hire good ones. Give them your confidence and support. Treat them like men. Cultivate and permit them to use their brains, tact, discretion. It pays.

ADVERTISING.

Advertising, as it is generally understood, has at best but a minor place in the central station commercial plan. The most effective printed advertising in the world will only carry a short way. It is simply a manifestation of the company's public policy and to be effective must be reinforced by fair, liberal and tactful management, and followed up by clean, businesslike and earnest solicitation.

But if we take the better and broader

meaning of the word, advertising is of next importance to management. As now understood by the most thorough advertising men, the word embraces whatsoever influences the public mind as related to the company. Thus, the neat appearance of your office boy is good advertising. A sweet-voiced, tactful telephone operator; a well-dusted window display; an attentive receiving teller; a good-natured, likable meter-reader; a well-timed contribution to charity; a good cigar and a warm handclasp offered in unison with sincerity to a newspaper man; quick, courteous attention to complaints; prompt apology for errors; earnest endeavor to serve any one anywhere at any time in matters electric —these are forms of advertising, and the best advertising. They cost nothing. They mark the successful manager. They are so intangible that one notes only their absence; their presence I have known to ward off municipal ownership and double dividends.

A certain amount of printed advertising is of course necessary and profitable, but it must be prepared with skill and care. If you have not the skill or lack time to bestow the care, hire it done. It is of the same importance and should have the same particular attention which your lawyer gives to a franchise or a contract. As a matter of fact, an advertisement is a contract and in some states can be enforced in court of law.

The most successful printed advertising for a central station is that which reflects most broadly to the advantage of the city. Be an enthusiast for the town. Find the opportunities for bragging, and whoop it up. Next in importance is educational advertising—the A B C's of electricity presented in words of one syllable. Such advertising lightens the work of your solicitor and brings voluntary inquiries for exact figures. Finally, there is the general publicity—interviews, personals, news of the company, write-ups of notable installations which gratify the merchant, stories of the wonders of electricity which make folk appreciate your service. These are all advertising, all easy to secure, all profitable when published.

Mr. Rae was followed by George Williams, who exhibited a large number of lantern slides showing interesting and spectacular examples of street, sign and outline lighting. Mr. Williams's remarks were brief comments on the installations shown, but he took pains to point out that the brilliant illumination of business streets serves the city as the best possible municipal advertising and greatly increases all local business. The policy of the lighting company, he said, should be to do whatever it can for the city in which it operates; to arouse public spirit, institute and encourage movements toward municipal betterments and make the people realize what a great and important part electricity plays in their prosperity. The views and remarks of Mr. Williams were received with enthusiasm, not only by members of the association, but by the business men present.

Glenn Marston was then introduced and gave a short talk on "Public Policy," saying, in part, "No farsighted public utilities man objects to reasonable state regulation; it is the unreasonable and municipal regulation that harms. Nor do we object to municipal ownership as such, but to the false showings made by municipally owned plants which make the public believe that such plants operate more cheaply than those owned by individuals or corporations." He then stated that reasonable control, which should include municipal with private plants, would show that business men can conduct their business better than politicians can conduct similar business for a city and, if the truth were known, no city would ever want municipal ownership. In dealing with the work of public utilities commissions, Mr. Marston pointed out that they were as beneficial to the small company as to the large and said unreservedly that no public service law, honestly drawn for the mutual protection of public and company; but would prove of immense benefit to the lighting industry.

T. Commerford Martin made an able address on the purposes of associations and the advantage of joining with the National Electric Light Association. After sketching briefly the history of the industry and quoting figures to show its huge importance to-day, Mr. Martin said that the future lies wholly with the central station managers. Touching the subject of state control, he pointed out that the public service commission is not a menace but a dam which will, in future, hold back any tide of socialism or worse evil which may arise, and predicted that within ten years every state in the Union will have such a commission. Mr. Martin's words in praise of the work done by utilities commissions in New York, Massachusetts and Wisconsin created a profound impression.

The purpose of Mr. Martin's address, however, was to urge the Vermont Electrical Association to co-operate with the national association, and in this he was successful.

The executive session was held just prior to the regular meeting on Wednesday afternoon. The question of co-operating with the state legislature in drafting a fair and equitable public-utilities bill was discussed at some length and steps taken toward this end. The matter of closer relationship with the National Electric Light Association was also favorably considered. The following officers were elected:

President, F. H. Parker, Burlington Light and Power Company, Burlington.

First vice-president, James E. Davidson, Consolidated Lighting Company, Montpelier.

Second vice-president, C. E. Parker, Vergennes.

Secretary-treasurer, A. B. Marsden, Manchester.

Members of executive committee: Three years, C. C. Wells, Middlebury, and George S. Haley, Rutland.

On Wednesday evening President Larrabee gave an informal dinner at the Bennington Club in honor of F. H. Parker, the incoming president of the association. The guests were:

F. H. Parker, Burlington, president-elect Vermont Electrical Association.

Hon. F. E. Howe, Bennington, representative to legislature and publisher of the Bennington *Banner*.

Hon. C. H. Dailey, Bennington, collector of customs.

I. E. Gibson, Bennington, president Bennington Club.

O. M. Barber, Bennington, attorney.

Colonel F. S. Richardson, Bennington.

A. B. Marsden, Manchester, secretary-elect Vermont Electrical Association.

George S. Haley, Rutland.

T. C. Martin, New York, editor *Electrical World*.

Harry C. Rice, Cleveland, vice-president G. I. Lamp Company.

George Williams, New York, Henry L. Doherty & Company.

Glenn Marston, New York.

Frank B. Rae, Jr., New York, editor *Selling Electricity*.

The clambake on Thursday was particularly enjoyable. The members of the association and their guests left the headquarters in the Putnam House at about 10.30 for the picnic grounds and amused themselves with various sports until the bake, which was ready shortly after one. The bake was pronounced "the best ever."

E. D. Strickland came down from Buffalo to direct a rejuvenation of the Sons of Jove. The ceremony was performed with much pomp and circumstance—and now nearly everybody in Vermont is a Jovian.

The Association of Edison Illuminating Companies.

The annual convention of the Association of Edison Illuminating Companies was held at the Hotel Aspinwall, Lenox, Mass., September 15, 16 and 17. The convention was called to order on Tuesday morning, September 15, at 9.30 o'clock, and the presidential address delivered by Alex Dow, of Detroit, Mich. The report of the executive committee was presented by W. W. Freeman, Brooklyn, N. Y., secretary, and the report of the treasurer by Louis A. Ferguson, of Chicago. J. W. Cowles, of Boston, presented the report of the Committee on Meters. A paper entitled "Measurements with Portable Testing Instruments" was read by F. P. Cox, of Lynn, Mass. The report of the Committee on Electric Heating was presented by John F. Gilchrist, chairman. This was followed by a paper entitled "A Study of Residence Lighting." The report of the Committee on Storage Batteries was presented by Louis A. Ferguson, Chicago, chairman, followed by a paper by P. S. Millar, of New York, entitled "A Review of the Policies Pursued by Edison Companies in Handling Incandescent Lamps." The report of the Committee on National Code was presented by William C. L. Eglin, Philadelphia, chairman.

The second session was held on Tuesday evening. The report of the Committee on Incandescent Lamps was presented by John W. Lieb, Jr., New York, chairman. John W. Howell, of the incandescent lamp department of the General Electric Company, Harrison, N. J., delivered a talk on "Recent Developments in Metal-Filament Lamps." A paper entitled "Probable Effects of the Higher-Efficiency Lamp on Central Station Income" was read by E. F. Tweedy, New York. A paper entitled "A Self-Supporting Tungsten Lamp Campaign" was read by M. S. Seelman, Jr., of Brooklyn.

The third session was held on Wednesday morning, when the report of the Committee on Steam Turbines was read by Charles N. Parker, Boston, chairman. A paper entitled "Operation of the Boiler Plant and Cost of Making Steam" was read by J. P. Sparrow, New York. A paper entitled "Supplementary to 1907 Paper, 'Steam Heating from Central Stations,'" was read by B. R. Fales, Detroit. A paper entitled "Modern Substation Apparatus" was read by E. M. Allen, Schenectady. A paper entitled "Single *Versus* Three-Phase Transformers for Distribution Purposes" was read by L. L. Elden, Boston. A paper entitled "Short-Circuits on Alternators" was read by E. J. Berg.

The fourth session was held on Wednesday evening. The report of the Committee on High-Potential Disturbances was presented by W. F. Wells, Brooklyn, chairman. Dr. Charles P. Steinmetz delivered a lecture entitled "Electrical Engineering Problems of the Future."

The fifth session was held on Thursday morning. The first paper was entitled "Some Advertising Notes, with Particular Reference to the Advertising Value of the Display Room," by Howard K. Mohr, Philadelphia. A paper entitled "The Status of the Special Customer" was read by James V. Oxtoby, Detroit. A paper entitled "Compensation to Injured Employés—Plan of the New York Edison Company" was read by E. M. Atkin, New York. The technical session was closed with a talk by Dr. Louis Bell, entitled "Lighting in Europe."

The following officers were elected for the ensuing year:

President—W. W. Freeman, Brooklyn, N. Y.

Vice-president — George H. Harries, Washington, D. C.

Secretary—D. L. Huntington, Spokane, Wash.

Treasurer—L. A. Ferguson, Chicago, Ill.

Executive committee—Samuel Insull, Chicago; Charles L. Edgar, Boston; John W. Lieb, Jr., New York; Joseph B. McCall, Philadelphia; Thomas E. Murray, New York.

Meeting of Railway Commissioners.

The annual meeting of the National Association of Railway Commissioners will be held at Washington, D. C., on October 6. This is the twentieth annual convention of the association. It is expected that the Interstate Commerce commissioners, the various commissioners who have been appointed by states throughout the Union, and prominent legislators, railroad men and financiers will be in attendance.

The committee to report on construction and operating expenses of electric railways is composed of James S. Harlan, Interstate Commerce Commission; Milo R. Maltbie, Public Service Commission, First District, New York; J. C. Morris, Ohio; William J. Wood, Indiana; William Kilpatrick, Illinois; Hartford Erickson, Wisconsin; Orasmus R. Fyler, Connecticut.

Pittsburg Section, American Institute of Electrical Engineers.

The September meeting of the Pittsburg (Pa.) section of the American Institute of Electrical Engineers was held in the lecture hall of the Carnegie Institute. The following officers were elected for the ensuing year: Chairman, W. Edgar Reed; secretary, B. P. Rowe; executive committee, C. B. Auel, B. Rutherfoord, F. Uhlenhaut, Jr., C. W. Davis, E. B. Tuttle, Ludwig Hommel.

Mr. Reed has had a broad experience in electrical engineering both in France and in America.

F. D. Newbury abstracted J. L. Woodbridge's paper on "The Application of Storage Batteries to the Regulation of Alternating-Current Systems." He explained how batteries were used in connection with rotary converters having two-part split pole-pieces and also rotary converters having three-part pole-pieces.

R. L. Flanders read a paper on the "Relay Type of Load Regulators for Storage-Battery Systems." He explained by diagrams how beautifully a relay can be used together with a battery to regulate the supply of alternating current through a rotary converter to produce a satisfactory supply of direct current.

P. M. Lincoln said that the idea carried in all electrical engineers' minds was that the ratio of the direct current to alternating current in a rotary converter was fixed; being for two-phase 1 to 0.7 and for three-phase 1 to 0.6. These ratios do not hold exactly and it has been known that by trimming the pole-pieces and giving the proper back charge, the ratios could be modified. The idea of changing the field form in order to change the alternating-current and direct-current ratio is believed to be original with Mr. Woodbridge. The two-part pole-piece rotary has the advantage of combining the functions of a rotary and regulator. The disadvantages are that it will probably be more expensive, have a distorted wave-form, the power-factor can not be made unity, and the conditions are favorable for resonance with large cable systems, and also for hunting.

J. L. Davis discussed Mr. Fessenden's paper on "Wireless Telephony." He explained how the energy began to flow out into space from the antenna harp when the frequency became 85,000 and from that figure on to 100,000 the energy radiated increased from zero to nearly 100 per cent. He also explained the design of a high-frequency generator, the ar-

rangement of Poulsen's arc, and the marginal method of tuning invented by Fessenden.

E. B. Tuttle spoke of the method of relaying telephone messages from wire lines to wireless transmitters, and *vice versa*.

S. P. Grace, in the discussion, spoke of the progress made in telephony. He started with the first form of telephone, that of iron rods driven into the ground outside of forts to indicate to the defenders any attempt of an enemy to tunnel into the fort, and showed what rapid progress had been made in the art. He referred to some early letters on the invention of the telephone written by T. A. Edison to T. B. A. David.

American Society of Mechanical Engineers.

The season of professional meetings of the American Society of Mechanical Engineers will be opened on Tuesday evening, October 13, by a meeting of the Gas Power Section in the Engineering Societies Building at 29 West Thirty-ninth street, New York city.

H. L. Doherty, chairman of the Meetings Committee of the section, will present a report for discussion outlining plans for future work, and there will also be a discussion of standards to be used in gas-power work.

Two papers will be read, one by D. A. Harvey on gas-producer plants, with data upon costs, performance, etc.; and one by N. T. Harrington, giving the results of tests to determine the loss of fuel weight in a freshly charged producer, due to increase of ash contents in the fuel bed. The first paper will be illustrated by lantern slides, showing actual plants and plans for the arrangement of apparatus.

Large Water-Power Development on the Mississippi River.

A 300,000-kilowatt water-power plant is to be erected by Cooper & Powelson at Keokuk, Iowa. The plans contemplate damming the Mississippi River in the rapids at Keokuk. Current for electric light and power is to be supplied to Keokuk, Davenport, Burlington, Rock Island and other manufacturing cities and towns in that district, and eventually to St. Louis, Mo. Mr. Cooper owns the government franchise to build a dam across the Mississippi River at Keokuk.

The Convention of the American Street and Interurban Railway Association.

The annual convention of the American Street and Interurban Railway Association and its affiliated and allied associations will be held at Atlantic City, N. J., October 12, 13, 14, 15 and 16. The American Street and Interurban Railway Manufacturers' Association is making great preparations for a magnificent exhibit, which will cover the entire area of Young's million-dollar pier. One hundred and fifty different companies have already been assigned exhibit space. The association booth for the registration and information of delegates and guests to all of the associations will be located at the Boardwalk entrance to the pier. The manufacturers' association will also have a booth at the same place, which will take care of similar matters relating to the exhibitors and the members of that organization.

All of the meetings of the American association and of the Transportation and Traffic association will be held in the Greek Temple, near the outer end of the convention pier. The Accountants will hold their two sessions on Wednesday, at the Chalfonte Hotel, and their Thursday and Friday sessions in the Aquarium Court Hall, near the Boardwalk end of the convention pier. The Engineers will hold their Tuesday and Wednesday sessions in the Aquarium Court Hall, and their Friday session in the Greek Temple. The Claim Agents will hold all of their sessions at the Traymore Hotel.

The following programme has been announced:

ACCOUNTANTS' ASSOCIATION.

Tuesday, October 13—2 to 5 P. M.—Registration and badges.

Wednesday, October 14—9.30 A. M. to 12.30 P. M.—Convention called to order. Annual address of president. Annual report of executive committee. Annual report of secretary-treasurer. Paper—"Organization of the Accounting Department of an Electric Railway and Light Company," by A. R. Patterson, general auditor Savannah Electric Railway Company, Savannah, Ga. Report of Committee on Collection of Blanks and Forms, by Elmer M. White, secretary Accountants' Association, Brooklyn, N. Y. Appointment of Convention Committee. New business.

Wednesday, October 14—1 P. M.—"Get together luncheon."

Thursday, October 15—9.30 A. M. to 12.30 P. M.—Paper—"Interline Accounting of Interurban Railways," by W. H. Forse, Jr., secretary and treasurer Indiana Union Traction Company, Anderson, Ind. Paper—"Accounting Methods of a Holding Company," by P. S. Young, comptroller Public Service Railway Company, Newark, N. J. Report of Committee on Standard Classification of Accounts and Form of Report. Report of Committee on International Standard Form of Report. Appointment of Nominating Committee.

Friday, October 16—9.30 A. M. to 12.30 P. M.—"The Effect of Electrification on the Accounting Methods of Steam Railways," by A. B. Bierck, general auditor Long Island Consolidated Electrical Companies, Long Island City, N. Y. Reports of Convention Committees. Report of Nominating Committee. Election of officers. Installation of officers. Adjournment.

ENGINEERING ASSOCIATION.

Tuesday, October 13—9.30 A. M. to 12.30 P. M.—Registration and badges.

Tuesday, October 13—2 P. M. to 5 P. M.—Convention called to order. Annual address of president. Annual report of executive committee. Annual report of secretary-treasurer. Appointment of Convention Committees. Report of Committee on Maintenance and Inspection of Electrical Equipment.

Wednesday, October 14—9.30 A. M. to 12.30 P. M.—Report of Committee on Standardization. Report of Committee on Power Generation.

Wednesday, October 14—2 P. M. to 5 P. M.—Report of Committee on Control. Appointment of Nominating Committee. Report of Committee on Power Distribution.

Thursday, October 15—9.30 A. M. to 12.30 P. M.—Inspection of exhibits.

Thursday, October 15—2 P. M. to 5 P. M.—Inspection of exhibits.

Friday, October 16—9.30 A. M. to 12.30 P. M.—Report of Committee on Car and Car-House Wiring. Report of Committee on Operating and Storage Car-House Designs. Question box.

Friday, October 16—2 P. M. to 5 P. M.—Report of Committee on Way Matters. Report of Committee on Economical Maintenance. General business. Report of Nominating Committee. Election of officers. Installation of officers. Adjournment.

CLAIM AGENTS' ASSOCIATION.

Monday, October 12—9.30 A. M. to 12.30 P. M.—Registration and badges.

Monday, October 12—2 P. M. to 5 P. M.—Convention called to order. Annual ad-

dress of the president. Annual report of the executive committee. Annual report of the secretary-treasurer. Appointment of Convention Committees.

Tuesday, October 13—9.30 A. M. to 12.30 P. M.—Paper—"The Organization of a Claim Department for a Small or Moderately Large Company, Including a School of Instruction as a Means of Preventing Accidents," by Francis J. Ryan, M.D., Syracuse Rapid Transit Railway Company, Syracuse, N. Y. Paper—"The Claim and Its Disposition," by Peter C. Nickel, claim agent New York City Railway Company, New York, N. Y.

Tuesday, October 13—2 P. M. to 5 P. M.—Paper—"Uniformity in Claim Department Records and Accounts," by John J. Reynolds, claim agent, Boston Elevated Railway Company, Boston, Mass. Paper—"The Duties of Claim Agents and Other Officials of Quasi-Public Corporations to the Public," by Eugene R. Roberts, attorney Knoxville Railway and Light Company, Knoxville, Tenn. Appointment of Nominating Committee.

Tuesday, October 13—8 P. M.—Social smoker and entertainment. (Place to be announced later.)

Wednesday, October 14—9.30 A. M. to 12.30 P. M.—Question box. Discussion—"The Medical Side of the Prevention of Accidents." General business. Reports of Convention Committees. Report of Nominating Committee. Election of officers. Installation of officers. Adjournment.

TRANSPORTATION AND TRAFFIC ASSOCIATION.

Monday, October 12—9.30 A. M. to 12.30 P. M.—Registration and badges.

Monday, October 12—2 P. M. to 5 P. M.—Convention called to order. Congratulatory address by Hon. W. Caryl Ely. Annual address of the president. Report of organization meeting. Annual report of the executive committee. Annual report of the secretary-treasurer. Appointment of Convention Committees. Reports of special committees. Paper—"How Can a Small Road Best Promote Traffic and Increase Its Revenue?" by Ernest Gonzenbach, general manager Sheboygan Light, Power and Railway Company, Sheboygan, Wis. Report of Committee on Training of Employés.

Tuesday, October 13—9.30 A. M. to 12.30 P. M.—Paper—"Carrying of United States Mail on Electric Railways, Its Advantages and Disadvantages, and the Compensation Therefor," by C. H. Hile, assistant to vice-president Boston Elevated Railway Company, Boston, Mass. Report of Committee on Freight and Express. Paper—"Progress to Date in Carrying Freight and Express Matter by Electric Roads—Some Mistakes That Have Been Made and Their Remedy," by C. V. Wood, general freight and passenger agent New England Investment and Security Company, Boston, Mass.

Wednesday, October 14—9.30 A. M. to 12.30 P. M.—Appointment of Committee on Nominations. Symposium—"The Possibilities of a Well-Conducted Publicity Department," by George Sabin Brush, clerk Transportation Department Boston Elevated Railway Company, Boston, Mass. B. R. Stephens, general traffic manager Illinois Traction System, Springfield, Ill. Charles E. Flagg, department of publicity Inland Empire System, Spokane, Wash. George H. Gall, publicity manager Washington, Baltimore & Annapolis Electric Railway Company, Baltimore, Md. Charles W. Lamb, advertising expert, Milwaukee, Wis. Report of Committee on Interurban Rules.

Thursday, October 15—9.30 A. M. to 12.30 P. M.—Paper—"The Operation of Multiple-Car Trains on Interurban Roads," by D. F. Carver, receiver Trenton & New Brunswick Railroad Company, Trenton, N. J. Report of Committee on Passenger Traffic. Report of Committee on Rules for City Operation. General business. Report of Nominating Committee. Election of officers. Installation of officers. Adjournment.

Canadian Bell Telephone Company Extending Its System.

It is announced at Montreal, Quebec, that the Bell Telephone Company will spend $1,000,000 in improving the company's service in Ontario and Quebec. The company is building through lines from Toronto to North Bay, a distance of 230 miles, to connect at the latter point with the Ontario Government system to the new districts of Ontario. Another line from Toronto to Parry Sound will be constructed to embrace a number of summer resorts in the Muskoka lakes district. An additional telephone line direct between Montreal and Quebec has been completed.

In Montreal the Bell Telephone Company is erecting a new exchange building in the north end to be known as the St. Louis exchange. In Toronto the company will put up a building, five stories high, sufficient to accommodate 20,000 subscribers. All long-distance work will be centred in this building. At Quebec a large addition is being built to the present exchange, which will be ready for occupation in about three months.

Modern Science Club.

The Modern Science Club will open its winter season at the club house, 125 South Elliott Place, Brooklyn, N. Y., with a smoker and entertainment on Tuesday evening, September 29.

The following announcements are made for the first month of the lecture course: October 6, Almet R. Latson, president of the Union League Club, of Brooklyn, will deliver an address entitled "The Sources of Our Law"; October 13, quarterly meeting of the club; October 20, Emil F. Jennert, superintendent of the Manhattan Brass Company, will deliver an address entitled "Voting Machines"; October 28, George A. Orrock, mechanical engineer of the New York Edison Company, will deliver an address entitled "Central Station Design."

Memorial to Alexander Graham Bell.

The people of Brantford, Ontario, have raised the sum of $40,000 for a memorial to Professor Alexander Graham Bell. It was just outside of the city that Professor Bell made his first successful experiments with the telephone, and Brantford has since been known as the "Telephone City." With the money subscribed several blocks of land in the centre of the city have been purchased and will be turned into public parks.

The October Meeting of the American Institute of Electrical Engineers.

The October meeting of the American Institute of Electrical Engineers will be held in the Auditorium of the Engineering Societies Building, 33 West Thirty-ninth street, New York city, on Friday, October 9, at 8 P. M. At this meeting a paper entitled "High-Potential Underground Transmission," by P. Junkersfeld and E. O. Schweitzer, of the Commonwealth Edison Company, Chicago, will be presented and discussed.

National Electric Lamp Association to Establish a Department of Physical Research.

The engineering department of the National Electric Lamp Association, Cleveland, Ohio, announces that Dr. Edward P. Hyde, now of the Bureau of Standards, Washington, D. C., after October 1 will organize and direct a department of physical research under the auspices of, and at the expense of, the association. Dr. Hyde will operate his department with entire freedom from commercial suggestion, and with the same frank publicity which has characterized his work at the Bureau of Standards.

The British Association Meeting.

The annual meeting of the British Association for the Advancement of Science was opened in Dublin, Ireland, on Wednesday, September 2, at the reception given to the council and delegates by the Lord Mayor and Lady Mayoress. The formal sessions began on Wednesday evening with the address of Francis Darwin, president of the association, in the course of which Mr. Darwin paid a touching tribute to the late Lord Kelvin, and stated that all kinds and classes of people alike lamented his recent death.

On the morning of Thursday, September 3, Dr. W. N. Shaw delivered his presidential address to Section A (mathematical and physical science). This address dealt almost entirely with meteorology. The remainder of this section's proceedings was of little interest to electrical engineers, with the exception of the report presented by Dr. R. T. Glazebrook, of the Electrical Standards Committee.

Section G (engineering) listened to the address by Dugald Clerk, its president. This dealt with the discovery and development of the laws of thermodynamics. A portion of the address is printed elsewhere in this issue. Gerald Stoney read a paper entitled "Recent Advances in Steam Turbines." The great progress which had been made in the building of turbines was called attention to. The largest steam turbine made in 1900 had a rated output of 1,000 kilowatts, while to-day there are quite a number of turbines installed with outputs ranging from 5,000 to 8,000 kilowatts.

On the morning of Friday, September 4, a joint meeting of Sections A, B and G was held, the topic for discussion being entitled "Gaseous Explosions." During the discussion of this subject Mr. Clerk stated that he had made some experiments with a view to ascertaining how completely combustion was effected when the gaseous mixture was exploded. With a mixture of one part of gas to seven of air he found that two and one-half per cent of the gas had not undergone combustion, and that the same figure applied to a one-in-ten mixture. He was of the opinion, however, that if a higher degree of accuracy could have been obtained, the percentage of unconsumed gas would have been five or six.

Sir William Ramsay read a paper entitled "Do the Radioactive Gases (Emanations) Belong to the Argon Series?" A paper entitled "On the Number and Absorption of the Beta Particles Emitted by Radium" was read by W. Makower. A paper entitled "The Rate of Production of Helium from Radium" was read by Sir J. Dewar.

On the morning of Monday, September 7, Section A opened its session by a discussion of the topic "Theory of Wave Motion," introduced by Professor Horace Lamb. A paper entitled "On the Measurement of Large Inductances Containing Iron" was presented by Sir Oliver Lodge and Benjamin Davies.

Section G listened to the reading of three papers concerning gas production and use. These papers are as follows: "The Utilization of Peat for Making Gas or Charcoal with Recovery of By-Products," by Captain H. R. Sankey; "Producer Gas," by J. Emerson Dowson, and "Suction Gas Producers," by P. W. Robson. This session was concluded by the reading of a paper entitled "The Study of Breakages," by R. Rosenhain, and a paper entitled "The Electrical Conductivity of Certain Light Aluminum Alloys, as Affected by Exposure to London Atmosphere," by Professor E. Wilson.

On Tuesday, September 8, Professor E. Rutherford read a paper entitled "The Scintillations of Zinc Sulphide," before Section A. This was followed by a paper by Horace H. Poole, entitled "A Determination of the Rate of Evolution of Heat by Pitchblende."

Section G listened to a paper entitled "The Laws of Flight," by F. W. Lanchester, and a paper entitled "The Causes of Wear in Motor Vehicle Machinery," by F. H. Royce.

The session of Section A on Wednesday, September 9, was devoted to meteorological subjects, and Section G listened to the reading of a paper by J. Brown and M. F. Fitzgerald, entitled "Experiments on Rotating Discs." This paper was followed by the closing paper, entitled "Urban and Suburban Transit and Methods of Railless Traction," by F. Douglas Fox.

The informal sessions were concluded on the afternoon of Wednesday, September 9, by a garden party given to the members of the association by the Lord Lieutenant at the vice-regal lodge.

New Wireless Test.

It is stated that Lee De Forest has arranged with the British Admiralty for exhaustive tests of his wireless telephone system. The experiments are expected to occupy several weeks.

Electrification Plans of the Delaware, Lackawanna & Western.

It is announced that electrification of the Delaware, Lackawanna & Western system from Hoboken to Morristown, N. J., will take place shortly after January 1. Plans are in readiness for making the change in motive power over the stretch of thirty-two miles, and actual work will begin as soon as the new tunnel through Bergen Hill is finished. This tunnel, which has been building for two years, will open for traffic on November 15. All grade crossings along the line will be abolished first and the tracks through the Oranges will be depressed. Motor-cars will be ordered which will be of a different type from the electric locomotives on the New York Central. These will draw the regular trains from Hoboken to Morristown, where the change to steam will be made on the trains running to Buffalo.

All told the cost of the various operations, including the tunnel, electrification, new cut-off at Lake Hopatcong and additional track laying, will total more than $25,000,000. This amount will be spent in three years' time.

New York Edison-Philadelphia Electric Outing.

Arrangements have been completed for a baseball game between the employés of the New York Edison Company and the Philadelphia Electric Company, to be held at the American League Grounds in Philadelphia, Pa., on Saturday, September 26.

A special train will leave West Twenty-third street, New York city, at 11.55 A. M.; Cortlandt and Desbrosses streets at 12 M., arriving at Broad Street Station, Philadelphia, at 2 P. M. Transportation to the grounds will be arranged for by the Philadelphia Electric Company, who will also furnish a collation and music at the finish of the game.

Illinois Central Electrification.

An exhaustive report, about completed, by the chiefs of various city departments of Chicago, Ill., on railroad electrification estimates the cost to the Illinois Central at $5,000,000. J. T. Harahan, president of the Illinois Central, says he will study every phase of the electrification problem and reach a decision as soon as possible. Louis C. Fritch, assistant to Mr. Harahan, is inspecting the operating conditions of the terminals electrified by the New York Central.

A UNIQUE WATER-POWER PLANT.

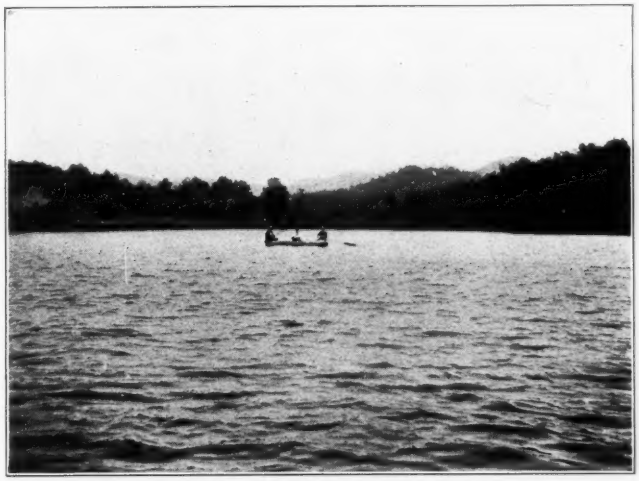
BY H. LESTER HAMILTON.

Probably at no other time in the history of the world has the subject of power and its efficient utilization been given so much attention as at the present. Scientists tell us that in a comparatively short time the rapid depletion of our coal deposits will necessitate the adoption of more efficient methods of transforming this latent energy. Mighty rivers, on whose bosoms could float the largest battleships, have been dammed to furnish power for hydroelectric plants, and countless Niagaras the world over are being enlisted in the same cause. Projects for utilizing the mighty power of the ocean waves are daily launched, and we occasionally read of some scientist who proposes to harness the potential energy of the thunder cloud in order that we may have a perpetual supply of electricity.

But how many of us, while listening to the murmur of the rippling brook, think of it as a power producer? Yet in the small streams of our country the energy of thousands of horse-power is daily going to waste, and all for the want of proper development. The cost of developing a water power of this nature is comparatively small, yet those who are in a position to reap the benefits which would be derived therefrom rarely take advantage of the opportunity. This condition of affairs may be attributed to one of two things: ignorance of the real value of the water power or lack of initiative.

This spirit of lethargy has, however, been shaken off in some parts of the country and enterprising persons have awakened to the latent power possibilities existing in nearby streams. Among this class the farmers are in the van, and not a few have harnessed their meadow brooks and are now enjoying luxuries which were not possible before.

Where the natural features are such that it is practicable to secure a considerable pondage and a fair head of water, a comparatively small stream can be made very valuable to the farmer. A water turbine can be installed to run a gristmill or sawmill during the daytime, the belt being shifted over at night to run a small dynamo for lighting the house and outbuildings. If the pond has sufficient capacity, the dynamo could also be run during the daytime to supply power for operating cream separators, cutting feed, elevating ensilage and hay, and for performing various other farm duties. During the winter months the surplus energy could be used for heating the house. Carrying it a little further, the laundry irons could be electrically heated, the sewing machine and ice-cream freezer motor-driven; chickens could be hatched in the electric incubator, the cows milked by a motor-driven automatic milker, and instead of carrying produce to town in the slow, creaky farm wagon, the swift, noiseless electric automobile could cover the distance in a third of the time. Ideal! Yes, but entirely possible to the fortunate possessor of a suitable water power.



A General View of the Mill Pond, Looking Up from the Dam.

An excellent example of the profitable utilization of a small water power, and one unique in some features, is found in the power plant of Christ School. This model school, nestled away among the hills of western North Carolina, commonly known as the "Land of the Sky," and not far from the city of Asheville, is almost a village in itself. There are several dormitories, an assembly hall, a chapel containing a miniature pipe organ, several workshops, and neat little cottages for the instructors. Not only is the mind trained, but the pupils are instructed in farm work, wood-working and domestic work as well. The making of beds and the sweeping of floors are as important a part of the daily routine as the memorizing of rules for extracting the cube root of a number. "The Galax Leaf," a little magazine published and printed by the students, is widely read by those interested

Looking Toward the Top of the Dam, and Showing the Building Containing the Grist Mill, Saw Mill and Dynamo Room.

A View Taken Below the Dam, Showing a Part of the Power-House on the Right.

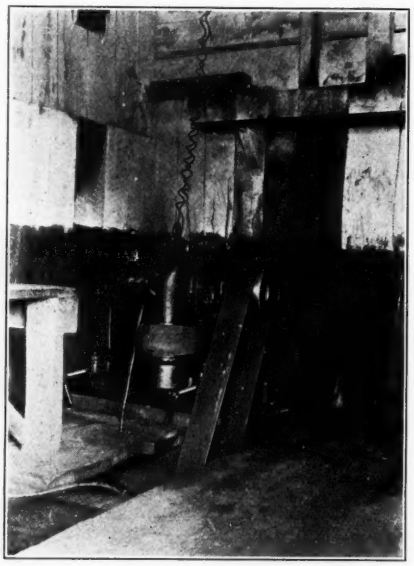
in the progress of the school. Not far from the school and down in the valley runs a little brook, rushing and tumbling through the fields, as is typical of most mountain streams. For years it had merrily gurgled its way over the pebbly bottom, occasionally bestirring itself to wash away the corn planted on its banks or to hollow out inviting swimming holes for the boys, but several years ago a progressive principal who was placed in charge of the school saw that by building a suitable dam across the brook enough water could be impounded to run a sawmill and a gristmill. The services of a local engineer were accordingly enlisted and a twenty-foot dam of rubble masonry was built, forming a pond some five acres in area.

An eight-horse-power water turbine of the horizontal type, together with the machinery for the gristmill and sawmill, was installed in a frame building just below the dam, the upper side of the structure forming part of the retaining wall. This building was later extended to make room for a small dynamo. During the daytime either the sawmill or the gristmill is operated, provision being made so that the belt can be shifted from one line shafting to the other. At night the belt is transferred to the pulley of the dynamo.

The sawmill, while not very complicated or of the latest design, manages to turn out very creditable work. The machines in use consist of a circular saw for ripping out rough boards from the logs as they are skidded into the mill, a cutoff saw for reducing them to a uniform length, and a combination planer and molder which converts them into flooring or plain boards, as the case may be.

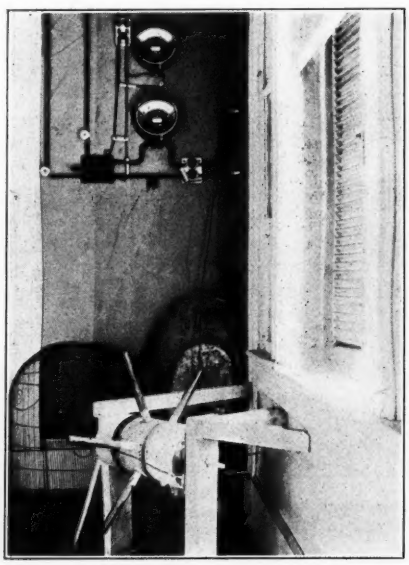
In the gristmill the corn and wheat, which are planted, cultivated and harvested by the pupils of the school, are ground and sacked ready for the market. A small proportion of the total grain crop is made up into bread and baked by these same students, the remainder being sold at a neat profit to Asheville merchants, who are always glad to buy the product of the Christ School mill.

The electrical end of the installation presents several interesting features. The dynamo, which is five kilowatts, or a little over six horse-power in capacity, is a two-pole direct-current machine giving forty amperes at 125 volts when driven at a speed of 1,100 revolutions per minute. Running under normal load it supplies current to some eighty-five sixteen-candle-power incandescent lamps in the various buildings on the hill. Owing to the character of the load, which is always steady, and the constant supply of water, due to the large area of the pond, no governor is needed other than a simple hand-wheel connected by a short iron rod to the gate valve of the turbine. The forward or



A View of the Dynamo Room.

backward turning of this hand-wheel varies the amount of water supplied to the turbine and enables quite a range of speed to be obtained. It is sometimes necessary



A View of the Controlling Room, Showing the Regulating Wheel and Switchboard Instruments.

to change the speed in the mill, especially when sawing different kinds of timber.

As the power plant is about one-third of a mile from the school, it was out of the question to go there at night to start and stop the machinery, and the expense of keeping an attendant did not seem justified. Neither did it seem advisable to allow the dynamo to run all night, as something might happen to stop the flow of oil to the bearings, in which case the machine might be seriously damaged. For this reason the following method of "remote control" was adopted:

On top of the hand-wheel regulating the water supply of the turbine, and securely fastened to it, is placed perpendicularly a wooden cylinder, about eight inches in diameter and a foot long. A small chain is wrapped several times around the cylinder, the ends of the chain being carried out through the side of the house, where they are fastened to two small iron wires, telephone wires, in fact. These wires extend along the transmission line to the principal's house, terminating in a room which might appropriately be called "the controlling room." At each pole the wires are strung through small pulleys in order to keep the friction down, the pulleys also serving as guides for the wires.

In the controlling room is placed a capstan or windlass, in appearance similar to the steering wheel of a ship, and around which the wires are fastened in the same manner as in the power-house. In other words, the controlling system consists of an endless chain fastened at each end to a movable cylinder, the cylinder fastened to the valve rod of the turbine moving in response to a movement of the cylinder in the principal's house, 1,700 feet away. Contrary to all expectations, this system of control has never caused the slightest trouble, not even during the trying winter months when the wires were covered with sleet and snow.

The controlling room is also the switchboard and distribution room, as here the transmission line from the power-house, after passing through a main switch, branches off to the various dormitories. An ammeter and voltmeter are the only indicating instruments, the switchboard equipment being completed by the necessary protective fuses and distributing switches.

The method of procedure in starting up is very simple. The wheel in the controlling room is turned until the voltmeter indicates that the dynamo has begun to generate. The different switches are then closed and further turning of the wheel, as soon as the ammeter shows that the dynamo has "picked up" its load, speeds the machine up until the voltmeter registers 110 volts. To allow for drop in

voltage on the various lines running to the dormitories, the needle of the voltmeter is generally held a little higher than this value.

It is very seldom that the voltage varies enough to be noticeable in the lamps, but should it do so, only a turn of the regulating wheel is required to bring it back to normal. At half-past ten, when the "lights-out" bell is rung, a few turns of the wheel quickly slow the dynamo down, and darkness reigns.

The remarkable success that has attended the operation of this little plant leads those in authority to believe that a much larger turbine and dynamo could be installed to advantage, and plans are being made to utilize this extra energy in heating the dormitories, furnishing power for a motor-driven fire pump and for various other operations around the school and on the farm. When these plans mature the Christ School power plant will stand as a monument to the energy and farsightedness of the man who first realized the true value of the little meadow brook, and it should act as an incentive to less enterprising owners of equally valuable water power. Even in its present condition it is an excellent example of what is possible to be accomplished by the proper development of small water powers.

Electrical Equipment for Santos Dock Company, Brazil.

The Santos Dock Company through whose docks most of the coffee exported from Brazil passes, has recently received from the General Electric Company complete generating station equipment—five revolving field, 3,000-kilowatt, 2,300-volt, three-phase, sixty-cycle, alternating-current generators; 350-kilowatt exciters; fifteen 1,000-kilowatt, step-up transformers, transforming generator voltage to 44,000 volts, with complete switchboard of most modern construction.

Some time ago a comprehensive order, including complete substation equipment, wiring and lighting supplies, and a large number of induction motors for operating air-compressors, hoists, cranes, etc., was received from the Santos Dock Company. This apparatus is now being shipped to Brazil.

The hydroelectric plant is located some thirty-five miles from the substation and, besides furnishing power for operating all the machinery at the docks, will also supply energy for light and power to various other industrial enterprises near the city.

THE KOKOMO, MARION & WESTERN TRACTION COMPANY.

BY C. A. TUPPER.

As an illustration of what may be accomplished in building up an existing electric railway, lighting and power distributing system, and at the same time strengthening the industrial position of an entire community, the management of the Kokomo, Marion & Western Traction Company furnishes one of the most striking and instructive examples to be met with anywhere in the country. At the time ownership of the system was assumed by the interests now in control, less than four years ago, there was a small street railway and electric lighting plant, having no greater output than 500 kilowatts, a few miles of trackage wholly within the city of Kokomo, and circuits containing several hundred arc and incandescent lamps. To-day 22,000 incandescent and 395 arc lamps in and about Kokomo are supplied with electric current and more than one-half of the company's customers have various electric household devices; factories in the vicinity take upward of 1,000 horse-power daily in current for operating motors; the street railway system has been extended to a trackage of ten miles, and a finely equipped interurban line of twenty-eight miles in length extends from Kokomo, a city of about 18,000 inhabitants, to Marion, having a population of 26,000, through several large towns situated in a rich, closely tilled agricultural country. Further extensions are projected to Terre Haute and Lafayette on the west, distant respectively, 130 and seventy-nine miles from the eastern terminus of the road. Among the principal places on the line now in operation are: Georgetown and Swayzee, each of about 2,000 people; Sycamore, Sims, Herbst and Roseberg.

Among outward signs of progress, however, the most prominent is the development of the new power station, which has recently been equipped with two Allis-Chalmers steam turbines and generators having an aggregate normal capacity of 2,000 kilowatts and delivering two-phase, sixty-cycle current at a terminal pressure of 2,300 volts. The first of these machines, put in operation February 21, 1907, was found so satisfactory that a second unit of identical construction was ordered, the latter being placed on the line December 7 of the same year.

Coal, consisting of a comparatively low grade of Indiana screenings, is brought in on a spur from the Lake Erie & Western Railway and unloaded through a trestle extending the entire length of the firing room, so that it is heaped up in front of iron doors opening upon the several furnaces. From these piles it is shoveled directly into the furnaces, which are so arranged as to obtain a relatively high heat value from the fuel—with the exercise of good management. Removal of ashes is accomplished by an inexpensive device. Instead of the customary ash pit with tracks and cars, there has been installed a tunnel and screw conveyer through which the ashes are constantly transferred to a pit outside the building. There, by means of a bucket elevator and inclined conveyer, the material is discharged to storage bins at one side of the building and unloaded into cars, which take it to points along the line where it can be used as ballast.

The boiler equipment, set on concrete foundations reaching to bed rock, consists of three batteries, two of which include four Stirling boilers, each having a capacity of 235 horse-power, and the third comprising one Atlas water-tube boiler with a capacity of 400 horse-power. Two of the Stirling boilers discharge into one stack six feet by eighty feet, constructed entirely of steel, and the remaining two, with the Atlas boiler, into a stack six feet by 125 feet, also of steel. The shorter of these stacks is equipped with an engine-driven blower, made by the B. F. Sturtevant Company, by means of which enough draft can be induced to give large temporary overload capacity to the two boilers with which it is connected. The boiler room has ventilators at the top and is very commodious with room for considerable additional capacity.

A main header, twelve inches in diameter, located above the pump compartment in the steam-turbine room, is in the form of a loop, from which each turbine unit is fed by a seven-inch pipe. Gate valves are placed between each battery of boilers and between each turbine inlet, these valves being of the Crane type with rising stems. There is also a four-and-one-half-inch auxiliary header. A proper arrangement of valves enables any part of the plant to be supplied from any boiler at will. All of the piping is made as short and direct as possible and heat insulation is provided in the shape of heavy covering of the pattern furnished by the H. W. Johns-Manville Company. Long bends to provide for expansion have, of course, been used wherever necessary, and the system includes Cochrane steam separators.

The condensers and all of the other

auxiliaries exhaust into a Cochrane heater (with Sorge water purifier) where a temperature of from 200 degrees to 212 degrees Fahrenheit—never less than 200 degrees—is maintained constantly. Water may be drawn from either the condenser suction or discharge pipes, from a deep well or from the city mains, and discharged into an elevated tank which feeds by gravity into the heater and from there by gravity into the boiler feed pumps; or the water may be by-passed directly to the boiler.

Two Worthington pumps are used for supplying the tank over the heater and two Dean pumps for boiler feed. Either one of any of these two is, however, of sufficient capacity to take care of the water system of the entire plant. The former are now being displaced by a centrifugal pump with two-and-one-half-inch discharge, driven by an induction motor supplied with current directly from the main generator buses through a step-down transformer; but the steam pumps will be held in reserve.

Water for condensation and boiler feed is taken from a creek, about 350 feet distant, through a sixteen-inch cast-iron pipe, and discharged back to the stream through twenty-inch tile. The water is drawn from a concrete basin in the creek, seven feet square inside and extending six feet below low-water mark, with walls extending to high-water mark and a gate on the down-stream side where the water enters. This gate can readily be closed down tight when desired and the water exhausted by pumps in the power plant, so as to facilitate cleaning the basin of sand and mud.

The turbine-operating floor is five and one-half feet above the boiler and pump-room floor, eleven feet above the basement floor and thirty feet below the roof trusses, the foundation of each generating unit being kept entirely separate from the steel frame of the concrete flooring. Overhead is a ten-ton crane, hand operated. In this room are placed two horizontal steam turbines and generators of 1,000 kilowatts capacity each, a 330-kilowatt engine-driven alternator operated in parallel with them, the exciters for these units, and substation apparatus, transformers, switchboard, etc.

Incorporated in these turbines are the various patented features controlled by the builders, the Allis-Chalmers Company, among which may be mentioned channel-shaped shrouds protecting the ends of the blading from injury; machine-cut slots in the foundation rings insuring accurate spacing of the blades; a method of fastening the latter which effectually prevents them from working loose, and improved balance pistons.

The turbines operate at 1,800 revolutions per minute, with a steam pressure of 140 pounds at the throttle, dry saturated, and a vacuum of twenty-eight inches of mercury referred to thirty inches barometer at the exhaust nozzle. Large temporary overload capacity has been provided for in the design of these machines; high efficiency is maintained, and close regulation secured under unfavorable operating conditions as a result both of good design and efficient station management. They are frequently run six weeks at a time without taking the load off and then only to make inspection.

The bedplate is divided into two parts, one carrying the low-pressure end of the turbines and the bearings of the generator, and the other the high-pressure end of the turbine. The turbine is secured to the former, while the latter is provided with guides which permit the turbine to slide back and forth with differences of expansion caused by varying temperature, at the same time maintaining the alignment. This arrangement permits of the utilization of the entire space between the foundation piers and below the turbine for the condensing apparatus. A grating is provided in the engine-room floor, directly over the condenser pumps and engines, so that operators above and below can watch each other's movements and signals, and the auxiliary engines can ordinarily be watched from above.

The condensers for the steam turbines are of the jet type built by Allis-Chalmers Company, each capable of giving the best possible service when its unit is operating at full rated load. Cycloidal air-pumps, direct-connected to enclosed, self-oiling, high-speed engines, and duplex, double-acting circulating pumps are installed with this apparatus, as is also a third condenser to take the exhaust from the remainder of the plant.

The speed of each turbine is regulated within close limits by a governor driven from the shaft through cut gears working in an oil bath. This governor, by means of a relay, operates a balanced throttle valve.

The lubrication of the four bearings, two for the turbine and two for the generator, is effected by supplying an abundance of oil to the middle of each bearing by means of a small cycloidal pump driven from the turbine shaft, and allowing it to flow out at the ends.

TURBO-GENERATORS.

The revolving-field alternators driven by these turbines are of Allis-Chalmers Company's standard type, designed for high efficiency and safe operation at high peripheral speeds. The field core is built up of steel discs, each in one piece, giving high magnetic permeability and great strength. Coils are placed in radial slots, avoiding side pressure on slot insulation and the complex stresses resulting from centrifugal force, which, in these rotors, acts normal to the flat surface of the strip windings. Bronze wedges hold the coils firmly in the slots, making the surface of the rotor a smooth cylinder, reducing windage losses and insuring quick operation; and the end connections are securely held by chrome nickel-steel rings, The stator is completely inclosed. Coils were wound and insulated before being placed on the core. Stator windings are placed in open slots and end connections are firmly braced.

Excitation of the two turbo-generators is accomplished by means of exciters of thirty-five kilowatts and thirty kilowatts, the former being driven by an Allis-Chalmers induction motor and the latter by an Erie Ball engine. The engine-driven unit has a five-kilowatt belted exciter. Turbo-generator excitation at full load is at 120 volts, 160 amperes. The exciters do not take care of the station lighting. Current for this is derived directly from the main bus-bars, or from a storage battery.

The character of the load put upon this station is railway, lighting and power combined. At present there is a normal consumption of current somewhat under the rated capacity of the turbines, so that one can be held constantly in reserve, and this drops to a minimum during the early morning hours of about 300 kilowatts.

A feature to be particularly commended is the thorough keeping of station records and the frequent checking of efficiencies of different parts of the plant. On the company's log sheet the daily load curve is plotted, thereby enabling it to be easily comprehended, for the twenty-four hours, at a glance. All costs and station performances are also recorded on the daily log. In addition to this records are kept in the office of the outside distributing circuits, and two Wright demand meters are constantly used to check the loads on lighting and power transformers over the town.

Alternating current is generated at two-phase, 2,300 volts, and transformed to three-phase, 11,000 volts, for transmission over the line of the interurban railway. In the main station there are used for this purpose three 150-kilowatt, oil-filled, self-cooled transformers, Scott connected, and

in the substation (seventeen miles distant) there are three 150-kilowatt step-down transformers, delta connected. These transformers have one-and-one-half-inch outlet pipes run directly through the floor, so that in case of fire oil can be emptied into barrels in the basement where the oil supplied is stored.

Direct current for the city railway system and ten miles of the interurban line is supplied through motor generator sets in the main station, delivering power at an operating pressure of 600 volts; and the substation at Swayzee, eighteen miles east of Kokomo, contains three rotary converters for the purpose of transforming the alternating to direct current. One of these, having a capacity of 200 kilowatts, is equipped with an induction starting motor, and two of seventy-five kilowatts each are started through a storage battery from the direct-current end.

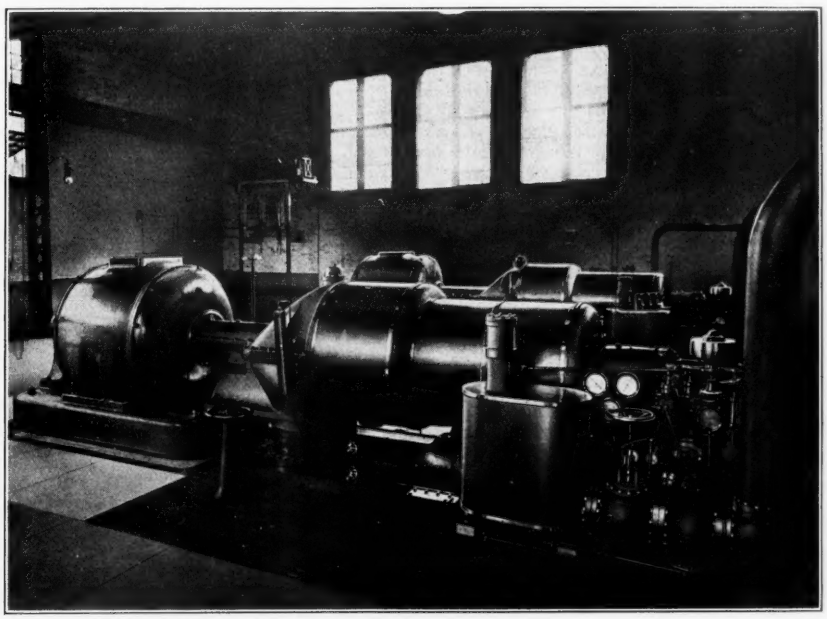
Current from the main generator busbars passes to the outgoing lines through double-throw switches, ammeters, wattmeters and fuses, all such circuits being also put through integrating wattmeters, 300,000-circular-mil cable being used, with high-voltage rubber insulation. The wiring from the generators to the switchboard is open work, fastened to the underside of the engine-room floor. The busbar system is in duplicate. Any machine or any feeder can be operated off of any set of buses. The switchboard rests on insulated stringers, with a panel and necessary apparatus for each turbo-generator and exciter.

The railway board consists of two panels, each controlling a 216-horse-power motor, and two panels each controlling the railway generators driven by these motors in the power plant substation. One panel contains the starting devices and a rheostat for these machines. There are also two feeder panels, one feeding the interurban line and the other on the city line.

Two panels control a storage battery and differential booster.

In a separate building, located about sixty feet from the main generating station, is a battery installation supplied by the Electric Storage Battery Company, which has a capacity of 480 ampere-hours and consists of 288 chloride accumulator cells. A smaller storage battery, consisting of the same number of cells, but having a capacity of 320 ampere-hours, is installed in the substation at Swayzee.

The lines are equipped with Westinghouse low-equivalent arresters and Westinghouse choke-coils, to which ready access is had from the gallery. The lighting feeders have General Electric lightning arresters and choke-coils manufactured at the station. On the direct-current railway system Garton lightning arresters are used, there being four of these to every mile. Wirt lightning arresters are provided at each transformer on the lighting circuit.



TWO 1,000-KILOWATT, 1,800-REVOLUTION-PER-MINUTE, SIXTY-CYCLE, ALLIS-CHALMERS STEAM TURBINES AND GENERATORS INSTALLED IN POWER-HOUSE OF THE KOKOMO, MARION & WESTERN TRACTION COMPANY, KOKOMO, IND.

The line of interurban road is built with easy curves and a maximum grade of no more than two degrees, most of the track being laid on the level. The right of way is forty feet wide and owned entirely by the company. Seventy-pound A. S. C. E. rail is used, joined by six-bolt standard splice bars.

The bonds are of the Ohio Brass Company's manufacture and consist of 0000 compressed bonds and soldered bonds on the interurban line and 00 compressed bonds on the city tracks. Rails are cross-bonded every half mile with 0000 copper wire.

The road is ballasted with crushed stone and gravel six inches deep, underneath the ties, 1,000 cubic yards of stone and 300 cubic yards of gravel being used to the mile. The ties are of white oak. Side-arm construction has been used for the entire course of the line, cedar poles being placed along ten miles of the interurban system, chestnut poles on the remaining eighteen miles and cedar and iron poles in the city. The brackets are nine feet, with one-and-one-half-inch tubing made by the Ohio Brass Company. The lightning arresters, four to the mile, are grounded by means of No. 4 copper wire and three-quarter-inch iron rods driven into the ground by the side of the pole and also connected to the rail. The wires consist of two 000 trolleys suspended by the Ohio Brass Company's Type "D" hangers. The feeder wires are 300,000 and 500,000 circular mil copper line feeding on to the interurban wires ten miles from the power station. The feeder from the substation is stranded aluminum equivalent to 300,000 circular mil copper. Spans are 100 feet in length.

There is a bridge crossing the Wildcat Creek near Greentown and there are two overhead railway crossings and several small steel culverts. The high-tension wires cross the bridges on timber projections at the sides of the bridge, the trolley wires being supported from stands fastened to the overhead steel work. At Marion the crossings which span the Pennsylvania and Chicago, Cincinnati & Louisville railways are of the girder type.

Everything connected with the physical equipment of the system has been very carefully looked after, and one of the best evidences of this is the power-house itself, which is a well-planned, well-built fireproof structure. The exterior walls are faced with standard pressed brick, laid in three-quarters English bond with headers in each fourth course, affording a thorough bond into the wall. All of the

interior surfaces in the engine room which have not been enameled are faced with Kokomo pressed sand brick of buff color and the remaining brickwork is of the ordinary kiln-run quality. Tile roofing covers the building.

The lighting system of the company has developed at an almost incredible rate. One feeder now goes out from the power station to the North Kokomo distribution system and another supplies South Kokomo, each being fed from the 2,200-volt, two-phase primary circuits; and in addition there are four series alternating-current arc circuits of fifty lights each, fed from transformers at 4,000 volts. The towns of Swayzee and Greentown are both furnished with lighting current taken through transformers from the high-tension lines and stepped down to 220 volts.

A stone quarry, which was originally owned and operated by the company in order to provide crushed rock for ballast, but has since passed into the possession of others, is located on the line of the interurban railway, and the larger part of the product of the plant, about 300 cubic yards per day, is transported by the company to the steam roads and out into various parts of the state for use in improving town and country roads. All of the machinery of this quarry used in crushing, elevating, etc., as well as of another quarry having similar capacity, is operated by motors running on alternating current taken from the power circuits.

Among other important customers taking power for motors are a brass works and spark-coil factory, two machine shops, a large flour mill, an automobile manufactory, bottling works, leather and harness establishment, glass factory, canners, planing mill, cooperage plant, mitten works, lumber yards, and nearly all of the smaller factories and shops in Kokomo, representing no less than eighty-four distinct industries. The use of small single motors and groups of two or three operated for various purposes is also growing throughout the city, so that electric drive has become one of the recognized features of the town. To accomplish this result, which has been brought about within comparatively recent time, T. C. McReynolds, secretary-treasurer and manager, and P. H. Palmer, the company's engineer and lighting superintendent, have made a systematic study of local power requirements and are prepared to give each prospective customer a detailed statement as to just what improvements can be effected in his particular case by the substitution of motor drive in place of power applied through shafting, belting, etc.

The company's campaign has not stopped at factories, shops, stores or industrial establishments of any kind, but has been carried into the homes of the city. Electric lighting is now becoming general and more than one-half of the company's customers have electrical apparatus of one kind or another, including laundry irons, heaters and cooking utensils. If progress made along this line during the next few years is at all commensurate with present indications, it will mean an enormous increase in business; and the probability is that more will be done in this direction than the most sanguine would believe, for the results of such work multiply almost in geometric ratio.

G. J. Marott, who lives in Indianapolis, is president of the company; T. C. McReynolds, secretary, treasurer and manager; P. H. Palmer, engineer, and H. P. Martzolf, superintendent of transportation. To each of these officials must be given credit for far more than the average enterprise and foresight and also to those actively concerned in the operation of the system for downright hard work.

Dark Spots with Alternating-Current Moving-Picture Machines.

To the Editor of the Electrical Review:

I was rather interested in a short article on the subject of dark pictures from a moving-picture machine, and having recently seen and tried the Kennelly stroboscopic fork at Atlantic City I thought I would show the article to a fellow townsman who is very successful in this line of business, having four shows on the road.

Instead of being interested in the article he was more amused and showed, from his experience, such a thing was impossible. In the first place, the alternations in the current are 7,200 per minute, or 120 per second, while the pictures move before the arclight beam at the rate of not more than fifteen to twenty per second, so that coincidence between the two is impossible.

He also stated that the majority of moving-picture men know nothing about lenses, and that most of the trouble comes from improper arrangement, and also from focusing. One rather startling thing he showed me was that the current used on his arc was sometimes more than sixty amperes, in some cases going as high as eighty. He says it is necessary to run it up to this in order to get a perfectly white screen, his sometimes being thirty feet in diameter.

E. W. Stevenson, E. E.

Wilkes-Barre, Pa., September 17.

THE DISCOVERY AND DEVELOPMENT OF THE LAWS OF THERMODYNAMICS.[1]—I.

BY DUGALD CLERK.

At the middle of the last century the steam engine had attained to a high degree of perfection. Its development was, it is true, incomplete; but it had been successfully applied to all the great duties of the mine, the waterworks, the factory, the railway and the steamship. The engines were mechanically excellent; the fuel economy was good, and they were built in units of thousands of horse-power. Steam power, in fact, was revolutionizing the whole of the social and industrial conditions of the globe. Notwithstanding this great material and engineering success, the world was in complete darkness as to the connection between steam motive power and heat. It was seen that motive power of almost any magnitude could be obtained by the agency of heat; but how it was obtained, and how much power was connected with a given quantity of heat, was quite unknown. The fuel consumptions of existing engines were known, and certain modes of improving economy were evident, and engineers were busily engaged in testing these modes by the slow but sure methods of invention, design, construction and operation in practical work; but in this they had but little aid from pure science. The science of thermodynamics did not yet exist.

New light was dawning, however, which gradually illumined the whole world of pure science and engineering practice.

Men of the first rank in intellect—Newton, Cavendish, Rumford, Young and Davy—had long before expressed the opinion that heat was not material in its nature, but was a mode of motion; but their opinions, although to some extent supported by experiment, made little impression upon the scientific world, and in 1850 we still find the most distinguished physicists adhering to the "caloric" or material theory of heat.

The great change from the errors of the old theories to the truth of the new was due to the work of Joule, Thomson and Rankine in Great Britain, and of Carnot, Meyer, Clausius, Helmholtz and Hirn on the Continent. The story begins with the work of Carnot in 1824, who published in Paris in that year a pamphlet entitled "Reflections Upon the Motive Power of Heat." He was attracted by the problem of the steam engine and the air engine.

[1] Presidential address delivered to the Engineering Section of the British Association for the Advancement of Science, Dublin, September 3.

He saw that heat and motive power were connected in some manner, and he endeavored to settle in a quantitative way the limits of that connection by the invention of an ideal series of operations, by means of which the greatest conceivable amount of mechanical power may be obtained from a given quantity of heat under given circumstances. For the purpose of his demonstration he assumes only two things: (1) That if heat be added to any body under standard conditions of temperature, pressure and volume, and the body be carried through any series of mechanical processes, returning ultimately to the standard condition of temperature, pressure and volume, then the quantity of heat added to the body is the same as that which has been discharged from it; (2) no process can exist whereby a given mechanical energy can increase its own quantity. On these indisputable assumptions he bases his ideal cycle, which consists of four simple and easily imagined operations, occurring within a cylinder behind a piston, so arranged that during the cycle work can be done by the working fluid upon the piston, or work done by the piston on the working fluid.

First Operation—The given volume of the working fluid is to be imagined as confined at its highest temperature and pressure behind the piston, and heat is to be added to keep the temperature constant, while the fluid expands, moving the piston and doing work upon it.

Second Operation—The supply of heat is cut off, and the working fluid expands, also doing work on the piston, while its temperature falls to the lowest point and its volume increases to its maximum.

Third Operation—The piston returns, compressing the working fluid, but allowing the heat of compression to escape, so that the temperature remains during the operation at its lowest point.

Fourth Operation—The piston compresses the working fluid, without allowing any loss of heat, to such an extent that the temperature rises again to its highest point, and the working fluid exists at the end of this operation at the same volume, pressure and temperature as at the beginning.

This assumed series of operations would give a certain available work area, the indicated power of the engine, inasmuch as the work done by the working fluid would be greater than that done upon it. If, however, it be assumed that in all the operations the direction of motion of the piston be reversed, then compression without loss of heat would take place in the second operation; further compression, but with sufficient heat loss to keep temperature constant, would occur in the first operation; the fourth operation would follow with expansion, and the third operation would conclude also with expansion. The engine would be reversed by beginning with the second operation, moving the piston backward in the order second, first, fourth, third. Carnot shows that this reverse operation would be performed by exactly the same amount of work as was given out by the direct operation, and that an amount of heat would be returned at the higher temperature equal to that which was added in the first case.

An engine which fulfils these conditions, Carnot states, will give the greatest amount of work which can be obtained from a given quantity of heat falling through a given temperature range. And it is evident that this must be so, because, if we assume the existence of any engine under the same conditions giving a greater amount of work from the same heat, then that engine could drive a Carnot engine in the reverse direction in such proportion as to return to the higher temperature a greater amount of heat than it abstracted, and so mechanical energy could be obtained without any heat fall whatever. This marvelous demonstration is obviously independent of the nature of the working fluid; it applies equally to all working substances, whether solid, liquid or gaseous, whether the physical state changes or not. It at once gives a standard of the limit of mechanical power which could possibly be obtained from a given amount of heat and a given temperature fall.

The Carnot cycle operations, as here given, are applicable either to the material or to the dynamical theory of heat; but Carnot originally stated that the whole of the heat added in the first operation was to be discharged in the third. Under the material or caloric theory work was supposed to be done by the fact of fall in temperature. Naturally, as the heat was material, it could not be destroyed or changed into mechanical energy. The production of mechanical energy was supposed to be incidental to the fall of temperature, much in the same way as mechanical energy was produced by the fall of water level, and this analogy is used throughout Carnot's work of 1824.

Carnot thus succeeded in proposing a standard of efficiency which was applicable to any heat engine, whatever the working fluid and whatever the operative cycle. By his method a limit could be set, fixing the maximum of mechanical energy to be obtained from a given heat quantity and a given temperature range. To reduce this to numerical values it was necessary, however, to experiment on any one working fluid within the desired temperature range in order to determine the work area in its relation to heat quantity and temperature fall. Carnot's writings show that he intended to make such observations; and had he succeeded, thermodynamics would have become a science at an early date. Carnot's death, however, in 1832, at the sadly early age of thirty-six years, prevented this development.

The name of Sadi Carnot will always be remembered by mankind as the founder of one branch of the thermodynamics of the heat engine.

His work remained practically without notice for thirteen years after his death, when, fortunately, it attracted the attention of William Thomson during his attendance at the laboratory of Regnault in the year 1845. Thomson was then twenty-one years of age, and had already attained a considerable scientific reputation. He took up the study of Carnot's work with enthusiasm. He became professor of natural philosophy in the University of Glasgow in 1846, and in 1848 he read a paper before the Cambridge Philosophical Society: "On an Absolute Thermometric Scale Founded on Carnot's Theory of the Motive Power of Heat and Calculated from Regnault's Observations." Like Carnot, Thomson accepted the material or caloric theory of the nature of heat, although, like Carnot also, he had doubts as to its truth. Assuming its truth, however, he carried Carnot's reasoning much further, and deduced from the Carnot cycle a thermometric scale which was absolute in the sense that it defined the idea of temperature independently of the properties of any particular body.

It is very difficult to carry one's mind back to the material theory of heat, but it is necessary to do so in order to appreciate the rigid accuracy of the reasoning of both Carnot and Thomson; and it is especially desirable to do so in order to understand the great step made in this paper. According to the caloric theory, heat was supposed to be a subtle elastic fluid which permeated the pores of bodies and filled the interstices between the molecules of matter. The fundamental quality imagined of this caloric or heat fluid was that of indestructibility and uncreatability by any humanly controlled process. Bodies became warmer when caloric was added to them, and grew colder

as it left them. Caloric, however, might be added to a body without heating it. In this case the heat was called "latent," and the state of the body changed from solid to liquid, or from liquid to vapor or gas.

Caloric, too, was required in greater quantities for some substances than others in order to warm the body equally. The capacity for caloric was thus greater in some bodies than in others.

If any particular body were heated without change of state, it was hotter—that is, its temperature rose when the quantity of caloric present was increased. It was not difficult to define equality of temperature. This was defined by a constant condition when brought into contact. But it was very difficult indeed to define temperature on any rational scale.

To the acute and brilliant intellect of William Thomson it became apparent that he had in the Carnot cycle a powerful instrument capable of widely general use, apart altogether from the theory of heat engines; and he here uses it in a most skilful way to give definiteness and universal application to the idea of temperature, as Professor Larmor states, "elevating the idea of temperature from a mere featureless record or comparison of thermometers into a general principle of physical nature."

Thomson accordingly defines equal differences of temperature in terms of the reversible or Carnot engine.

Equal temperature differences are to be differences between the temperatures of the source of heat and the refrigerator, when the proportion of work produced from a given quantity of heat is the same. Thermometers graduated in degrees calculated in this way could naturally be treated as instruments based on definite principles, independently of any properties of any particular material. The idea of temperature here was in rigid logical consistency with the caloric theory of heat, and it carried out completely the analogy between power derived from the same quantity of heat falling from a higher to a lower level, and resembling a fall of water in producing its effects. For equal quantities of caloric, as of water, temperature fall was regarded as similar to fall in space, and so an accurate idea of the nature of temperature difference is attained.

This definition, however, gave a scale greatly differing from that of mercurial, air and other thermometers, the degrees defined by it corresponding to larger and larger intervals on the air thermometer as temperature increases. Professor Tait pointed out also that on such a scale the temperature of a body totally deprived of heat is negative-infinite.

All these difficulties do not detract from the fundamental importance of the idea here enunciated for the first time: the idea of an absolute thermometric scale theoretically applicable to all bodies—solid, liquid and gaseous. On the caloric or material theory of heat, motive power is obtained during the letting down or fall from a higher to a lower level of a given quantity of heat. The quantity of heat does not alter in the process; it is only its relative level which alters. There is no reason, therefore, for mentally limiting the amount of mechanical energy obtainable from any given quantity of caloric, just as there is no reason for limiting the amount of mechanical energy to be mentally derived from a given weight. Any desired quantity of energy may be derived from a weight of, say, one pound, if it only be allowed to fall far enough, assuming gravity to be constant through the range.

The investigation of the work to be derived from a given quantity of heat at a given temperature is thus a matter of experiment, which can be settled by measurement of the properties of a few bodies.

Reasoning, it is conceived, in this way, Thomson follows up his absolute thermometric scale work with an investigation entitled "Carnot's Theory of the Motive Power of Heat," described in a paper read in 1849 before the Royal Society of Edinburgh, in which he calculates from Regnault's experiments on steam the power developed by a Carnot reversible engine when using one-centigrade heat unit; that is, the heat necessary to heat one pound of water through one degree centigrade for temperatures from one degree to 231 degrees centigrade, the temperature falling in the engine in each case to 0 degree centigrade.

In this paper he asks himself two questions: (1) What is the precise nature of the thermal agency by means of which mechanical effect is to be produced without effects of any other kind? and (2) How may the amount of the thermal agency necessary for performing a given quantity of work be estimated?

Using Regnault's values for the properties of steam, he calculates the lines of compression and expansion without heat loss, the lines of compression and expansion with heat flow at the lowest temperature, and heat addition at the highest temperature, and thus arrives at the work area per heat unit let down. He tabulates these results and shows that what he calls "Carnot's function" diminishes as temperature rises, using the ordinary centigrade scale. On the caloric theory the methods are rigidly logical and correct, but some inaccuracy is introduced by the necessity of that theory for the discharge of the same amount of heat at the third operation as is taken in on the first. The paper is of great interest, however, because it shows clearly how fully the distinguished author realizes the necessity for re-examining the standard ideas of the nature of heat. Two paragraphs make this very clear:

"7. Since the time when Carnot thus expressed himself the necessity of a most careful examination of the entire experimental basis of the theory of heat has become more and more urgent. Especially all those assumptions depending on the idea that heat is a substance, invariable in quantity, not convertible into any other element, and incapable of being generated by any physical agency; in fact, the acknowledged principles of latent heat would require to be tested by a most searching investigation before they ought to be admitted, as they usually have been, by almost every one who has been engaged on the subject, whether in combining the results of experimental research or in general theoretical investigations.

"8. The extremely important discoveries recently made by Mr. Joule, of Manchester, that heat is evolved in every part of a closed electric conductor moving in the neighborhood of a magnet, and that heat is generated by the friction of fluids in motion, seem to overturn the opinion commonly held that heat can not be generated, but only produced from a source where it has previously existed either in a sensible or in a latent condition. In the present state of science, however, no operation is known by which heat can be absorbed into a body without either elevating its temperature or becoming latent, and producing some alteration in its physical condition; and the fundamental axiom adopted by Carnot may be considered as still the most probable basis for an investigation of the motive power of heat, although this, and with it every other branch of the theory of heat, may ultimately require to be reconstructed upon another foundation when our experimental data are more complete. On this understanding, and to avoid a repetition of doubts, I shall refer to Carnot's fundamental principle, in all that follows, as if its truth were thoroughly established."

In these two paragraphs Thomson sums up the whole situation in 1849, and promises further investigation and further

attempts to deduce the nature of the connection between heat and work.

Assume, then, the truth of the caloric theory of heat, as Thomson does in the 1849 paper; we have a complete theory of the heat engine, based on the Carnot cycle, accounting for efficiencies which vary with temperature differences, but requiring no definite mechanical equivalent of heat; nay, antagonistic to the existence of such an equivalent. The caloric theory, as has been pointed out, is quite consistent with the theoretical possibility of obtaining an indefinitely great amount of mechanical energy from any given quantity of heat, provided the letting down, or fall of level, be indefinitely great.

At the time we are discussing—1850—the bare conception of the idea of an absolute zero of temperature is one which is startling in its boldness, and it must have been difficult, indeed, then to imagine any definite line of proof which could be followed to establish the real existence of such a physical limit. We are so familiar with the existence of very high temperatures, vastly transcending the temperatures in which we personally exist, that we can hardly conceive a temperature limit on the ascending side—that is, we can hardly think of any given high temperature which could not, under quite conceivable circumstances, be exceeded. We know, for example, that any metal—say, platinum—may be melted if its temperature be sufficiently increased; that a further sufficient increase will convert the liquid metal to the gaseous state, and that the gaseous metal may be heated indefinitely while in that state. We know the behavior and properties of many substances at high temperatures, and are aware of the strong tendency of all chemical compounds, when highly heated, to split up into the elementary bodies composing them. All this we appreciate, but we find it difficult to see how a point of temperature could be reached when it could be said: This is a physical limiting point on the ascending scale; we may heat a substance up to this temperature, but it is impossible to conceive of any higher temperature. It is necessary here to distinguish between a conceivable limit to an ascending temperature and a practical limit under existing conditions. We may thus place limits, say, to the temperature of coal-gas and air explosions, or the temperatures possible from the electric arc; the limit with coal-gas and air depending on one set of conditions, and the electric arc upon another set, such as the vaporizing point of carbon, and so on. In the same way, at the middle of last century it would have been considered quite reasonable to suppose that human existence was carried on at an intermediate plane of temperature, and that temperatures might exist as low, relatively to our mean temperature, as our known furnace and combustion temperatures are high. At this time, no doubt, such an idea was quite a reasonable one.

No such limit could be proved, even by the aid of the Carnot cycle, reasoning on the material theory of heat. If we assume that heat is material, and that in some way temperature fall doing work resembles, as Carnot supposed, the fall of water doing work in passing from a higher to a lower level, then no absolute zero is possible, because the same quantity of heat is supposed to exist at the low as at the high temperature. On this theory nothing in the idea of temperature suggests a possible physical limit. On the material theory the notion of temperature is one to which it is exceedingly difficult to attach a precise meaning.

Thomson's promises of further investigation were fulfilled in 1850, in which year he definitely accepted the dynamical theory of heat, and finally abandoned the material. His conclusions are given in a memoir of the first importance, which was read before the Royal Society of Edinburgh in 1851. It was entitled "On the Dynamical Theory of Heat." Before dealing with it, however, it is desirable to consider the work of Joule and others on another side of thermodynamics.

Long before 1850 the equivalence of mechanical work and heat quantity had been accepted by many scientific men, and Rumford had, indeed, made measurements of a rough kind. It remained, however, for Joule experimentally to determine the mechanical equivalent in the most accurate manner, and place what is now known as the first law of thermodynamics upon the sure basis of absolute experimental determination. His first paper was read before the Cork meeting of the British Association in 1843, and at the Oxford meeting in 1847 he read another, "On the Mechanical Equivalent of Heat," describing the results of experiments with paddles rotating in liquids driven by falling weights. By these years of work he had absolutely demonstrated the equivalence of heat quantity and mechanical work, so that no loophole of escape seemed possible; it appeared as if the material theory was rendered intellectually impossible to the trained intellect. This was not the fact, however, as is evident from both Joule's and Thomson's accounts of that British Association meeting.

Joule's earlier paper had been coolly received. Indeed, it is evident that the idea of a mechanical equivalent of heat was still distasteful to the physicists of the day, and its discussion was looked upon with dislike. Joule, at the 1847 meeting, addressed a small audience, and the account of his experiments was received without enthusiasm. This adverse atmosphere, so discouraging to the investigator, was quickly removed, however, when a young man rose to make his remarks and, by his enthusiastic comment and clear reasoning, at once succeeded in attracting the interest of those present. This young man was William Thomson, Professor of Natural Philosophy in the University of Glasgow. Speaking of this, his first meeting with Joule, at Manchester forty-six years later, Lord Kelvin said: "I can never forget the British Association at Oxford in the year 1847, when, in one of the sections, I heard a paper read by a very unassuming young man who betrayed no consciousness in his manner that he had a great idea to unfold. I was tremendously struck with the paper. I had first thought it could not be true because it was different from Carnot's theory, and immediately after the reading of the paper I had a few words of conversation with the author, James Joule, which was the beginning of our forty years' acquaintance and friendship. . . . I gained ideas which had never entered my mind before, and I thought I, too, suggested something worthy of Joule's consideration when I told him of Carnot's theory." This meeting was indeed fateful for the future of the science of thermodynamics, as it resulted in co-operation between two men of giant intellect, who between them performed most of the experimental work which was necessary to make thermodynamics an exact science. Their work alone sufficed to place the first and second laws of thermodynamics on the firm footing of accurate experiment and logical deduction.

Although Thomson was much struck by Joule's experiments, he did not accept the dynamical theory of heat at once. As he stated himself, "I had first thought that it could not be true because it was different from Carnot's theory."

Joule's discoveries at this date may be thus expressed:

Heat and mechanical energy are mutually convertible, and heat requires for its production, and produces by its disappearance, mechanical energy in the proportion of 1,390 foot-pounds for each

centigrade heat unit, a heat unit being the amount of heat necessary to heat one pound of water through one degree centigrade.

Knowing, as Thomson did, that mechanical energy could be produced by the agency of heat, but that its amount varied with the temperature and temperature fall, Joule's discoveries seemed antagonistic to Carnot's demonstration; and, convinced as he was that Carnot's law was true, he naturally felt at first that there must be some other way of looking at Joule's discoveries seemed antagonistic himself.

Joule naturally believed in his own manner of looking at his results, and he apparently agreed with Thomson as to the antagonism between what may be here called the Carnot and Joule laws.

The material theory of heat might have been true; in which case there was no more need for any direct quantitative connection between heat quantity and mechanical energy than between the mass of a body and its mechanical energy. Any unit of mass may acquire any conceivable amount of mechanical energy if its velocity be great enough, and so any unit of heat on the caloric theory may produce any conceivable amount of mechanical energy if the temperature fall be great enough. Joule considered the Carnot law to be so inconsistent with his law that in one of his papers he proposes its abandonment as inconsistent with discovered facts. At this point the two ideas seem to be in opposition. The germ of reconciliation, however, is found in observations by Thomson in both the 1848 and 1849 papers. In paragraph eight, quoted here from the latter paper, it is stated:

"In the present state of science, however, no operation is known by which heat can be absorbed into a body without either elevating its temperature or becoming latent, and producing some alteration in its physical condition."

This is equivalent to saying that no case has been observed where heat disappears doing mechanical work. In a note occurring in the same paper he alludes to the fact that engineers always assume that the amount of heat found in the condenser of the steam engine was the same as that taken into the engine by the steam, in the following terms:

"So generally is Carnot's principle tacitly admitted as an axiom that its application in this case has never, so far as I am aware, been questioned by practical engineers."

This was quite accurate. Hirn's demonstrations that heat disappears in a steam engine when work is done were not made until 1857, eight years later.

In the 1848 paper he states:

"The experiments of Mr. Joule, of Manchester, seem to indicate an actual conversion of mechanical effect into caloric. No experiment, however, is adduced in which the converse operation is exhibited; but it must be confessed that as yet much is involved in mystery with reference to these fundamental questions of natural philosophy."

Here we find Thomson's mind engaged —in 1848 and 1849—with the very matter requiring proof. Joule had proved the generation of heat by means of mechanical work; Thomson required the proof of the converse case—the disappearance of heat when mechanical work was done by the working fluid.

This proof was forthcoming in the results of experiments on the compression and expansion of air. Accordingly, we find the Carnot and Joule principles reconciled in Thomson's paper of 1851, and the important deduction made of an absolute zero of temperature —273 degrees on the centigrade scale. The introduction of the idea of the mechanical equivalent of heat leads at once to an absolute zero of temperature, and allows of the determination of this physical lower limit by the use of the Carnot cycle for investigating the efficiency of a perfect engine using any working fluid. Air was the working fluid actually investigated, and the determination of its properties at ordinary temperatures was a vitally important result of the co-operation of Thomson and Joule. Their experiments lasted for many years, and their rigorous investigation disclosed the fact that internal work was done in expanding a gas; in fact, that in a gas expanding isothermally doing work, part of the heat only disappeared in external work and part was absorbed in separating the molecules.

The Joule and Carnot laws are now known as the first and second laws of thermodynamics.

The second law, in modern form, may be thus stated:

Although heat and work are mutually convertible, and in definite and invariable proportions, yet no conceivable heat engine is able to convert all the heat given to it into work. Apart altogether from practical limitations, a certain portion of the heat must be passed from the hot body to the cold body in order that the remainder may assume the form of mechanical energy.

The proportion of the total heat convertible into mechanical energy depends on the absolute temperatures of the hot and cold bodies; it is unity minus the lower absolute temperature upon the upper absolute temperature.

It appears that during Thomson's struggle to reconcile the two apparently opposing laws, Clausius, who had seen the same difficulty, arrived independently at its solution and published a paper "On the Motive Power of Heat and the Laws of Heat Which May Be Deduced Therefrom," at the Berlin Academy, in February, 1850. In this paper Clausius discusses Thomson's difficulties, and also arrives at the conclusion that the Carnot cycle may be reconciled to Joule's law by the omission of the supposition that during the third process the same amount of heat is discharged from the cool body as was taken in from the hot one. He states:

"On a nearer view of the case we find that the new theories were opposed, not to the real fundamental principle of Carnot, but to the addition that no heat is loss. For it is quite possible that in the production of work both may take place at the same time: a certain portion of heat may be consumed, and a further portion transmitted from a warm body to a cold one; and both portions may stand in a certain definite relation to the quantity of work produced. This will be made plainer as we proceed; and it will be, moreover, shown that the inference to be drawn from both assumptions may not only exist together, but that they may mutually support each other."

In his 1851 paper Thomson gives Clausius full credit for solving the difficulty between the Carnot and the Joule principles. Thomson gives Clausius the full credit for priority, but states that he was working on the same problem, and had arrived at the same solution in the year 1850, before he had seen Clausius's work. Clausius, however, assumed the theory of a permanent gas, which required the absence of internal work, but Thomson was not prepared to assume this without experiment. This determination rigidly to prove every necessary assumption, and his clear conception of the points necessary for proof, led to the extensive series of researches undertaken by Thomson and Joule with the object of determining how much gas thermometers differ from an absolute scale as determined by the combination of the Joule and Carnot laws.

(To be continued.)

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

ELMIRA WATER, LIGHT AND RAILROAD COMPANY.

The earnings of the railroad department of the Elmira Water, Light and Railroad Company for the quarter ended June 30 shows gross of $58,117; expenses, $42,222; net, $15,895; other income, $2,914; total income, $18,809; charges, $15,589; surplus, $3,220.

KANSAS CITY RAILWAY AND LIGHT COMPANY.

The report of the Kansas City Railway and Light Company for the fiscal year ended May 31 shows gross earnings of $6,070,116; operating expenses, $3,228,170; net earnings, $2,841,946; other income, $105,680; total income, $2,947,626. This was $122,186 more than that for the fiscal year ended May 31, 1907. The balance available for dividends amounted to $853,132.

PHILADELPHIA RAPID TRANSIT COMPANY.

The annual meetings of the Union Traction Company and the Philadelphia Rapid Transit Company were held in Philadelphia on September 16. The directors of the Union Traction Company were re-elected and two new directors were elected to the board of the transit company.

The report of the Philadelphia Rapid Transit Company showed that the deficit for the last fiscal year is only $92,048.78. Receipts from all sources amounted to $18,557,502.86; cost of operation, licenses, taxes and fixed charges, $18,649,551.64. The deficit for the preceding fiscal year was $364,048.53.

A resolution was carried to increase the indebtedness of the company from nothing to $5,000,000. This loan is to be met with the unencumbered assets of the Union Traction Company as collateral, and includes valuable securities of the various underlying companies.

CUMBERLAND TELEPHONE AND TELEGRAPH COMPANY.

The report of the Cumberland Telephone and Telegraph Company for the month of August and eight months ended August 31 shows gross for August of $490,511; expenses, $287,636; August net, $201,875; interest and taxes, $37,724; August surplus, $164,151. Eight months' gross, $4,046,583; expenses, $2,353,317; eight months' net, $1,693,266; interest and taxes, $298,081; eight months' surplus, $1,395,185.

MONTREAL STREET RAILWAY COMPANY.

The report of the Montreal Street Railway Company for the month of August and eleven months ended August 31 shows August gross of $329,772; expenses, $164,262; August net, $165,510; charges, rentals, etc., $70,077; August surplus, $95,432. Eleven months' gross, $3,329,059; expenses, $1,978,659; eleven months' net, $1,350,400; charges, rentals, etc., $586,966; eleven months' surplus, $764,434.

AMERICAN RAILWAYS COMPANY.

The report of the American Railways Company for the year ended June 30 shows gross income of $2,927,436; receipts, income from stocks and bonds owned, $479,029; miscellaneous income, $17,728; total income, $498,757; total deductions, $171,645; net, $327,112, equal to 6.4 per cent on the $5,095,100 capital stock. The gross earnings of the subsidiary companies increased $59,280 over 1907, or 2.07 per cent. The total number of passengers carried was 68,762,586, an increase of 1,137,855. Stockholders were paid $305,706 in dividends, leaving a balance of $21,406 to be added to the surplus account. The American Railways Company controls the Bridgeton & Millville Traction Company, Bridgeton, N. J.; Springfield Railway Company, Springfield, Ohio; People's Railway Company, Dayton, Ohio; Altoona & Logan Valley Electric Railway Company, Altoona, Pa.; Chicago & Joliet Electric Railway Company; Chicago & Desplaines Valley Electric Railway Company, Joliet, Ill., and Scranton Railway Company, Scranton, Pa.

Steam Turbines in Power Stations.

Harry Webster, associate member of the Institution of Electrical Engineers of Great Britain, presents a summary in the *Electrical Review* (London), September 4, of facts and knowledge which he considers, from his experience, to be of the greatest importance. In operating steam turbines of the Parsons type the temperature of the steam should not exceed 550 degrees Fahrenheit. This will give all the usual advantages to be obtained by the use of superheat without danger in a well-constructed turbine. A good mercury pocket at the steam inlet to the turbine is essential, with a properly protected thermometer kept in continuously, so that the temperature of the steam can be noted at any moment. A sudden rise of temperature from any cause may do considerable mischief in a very short time. A precaution which can not be too carefully observed is the prevention of any solid matter coming over with the steam. Good lubrication is of the greatest importance, and can be achieved by using a good mineral oil, keeping all trace of water out of it. Water can only get into the oil at two or three places, and will generally be found to proceed either from the steam sealing devices at the ends of the turbine or from the water in the oil-cooling tank. This can easily be located by separating a small quantity of water from the oil and putting it through the standard soap test for hardness. Should it prove to be hard water, the fault should be looked for in the oil-cooling tank; but, if distilled, it must be proceeding from the sealing glands. There is every reason to expect a large demand for low-pressure or exhaust-steam turbines, as undoubtedly a great number of really modern and efficient reciprocating engines are in use at the present time, and it is often preferable to install a low-pressure turbine to take the exhaust from these, and thus utilize every available pound of steam rather than to scrap the engines. Some good examples of this combination are already installed and are giving excellent results, the working pressure of the steam being as low as one pound per square inch. Mr. Webber considers that the barometric condenser is of the greatest advantage in a steam-turbine installation, but the governing feature, when deciding upon the type of condenser, will be the quality of water available. A point which it is well to bear in mind with condensing plant for steam turbines is that, owing to the absence of oil, all iron and steel parts are liable to rusting. He has found that steel rings fitted to the buckets of air pumps rust quickly, although the bucket and barrel are bronze; whereas phosphor-bronze rings last indefinitely.

Georgia and Florida Independent Telephone Companies.

A convention of independent telephone companies from Florida and Georgia was held at Bainbridge, Ga., on September 11. The convention was largely attended, some 16,600 telephones being represented. A permanent organization was effected, with the following officers: President, Dr. J. G. Dean, Dawson, Ga.; secretary and treasurer, W. N. Drake, Pelham, Ga.; vice-president for Florida, Dr. W. L. Moor, Tallahassee; vice-president for Georgia, T. E. Gurr, Bainbridge.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

Electrical Equipment of the Royal Mail Steamship Orcoma.

The Pacific Steam Navigation Company's new twin-screw steamship Orcoma, of 11,532 tons, is the newest and largest of the company's fleet. The electrical equipment marks an advance in steamship fitting-up. Accommodations have been provided for 250 first-class passengers, 200 second-class passengers and a large number of third-class passengers. The machinery consists of two sets of quadruple-expansion, four-crank engines having cylinders twenty-six inches, thirty-seven and one-half inches, fifty-three and one-half inches and seventy-six inches in diameter by fifty-four-inch stroke, with three double-ended and three single-ended boilers for a working pressure of 210 pounds per square inch. The electric generating plant consists of four sixty-five-kilowatt, 110-volt, continuous-current generators, direct-driven by high-speed engines. The ship's lighting comprises 1,500 sixteen-candle-power incandescent lamps, three arc lamps for cargo purposes, and one Admiralty type Morse code signaling lamp. One of the large whistles is controlled by an electrical apparatus which admits of its being operated by a small handle on the navigating bridge. It can, in addition, be switched on to a special clock in the wheel-house which blows the whistle automatically at intervals of every sixty seconds. The ventilating plant consists of two eight-horse-power Allen enclosed motors driving Sirocco fans for ventilating the stoke-holes; four enclosed motors driving fans for ventilating the galleys and lavatories, and sixteen fifty-four-inch ceiling fans for ventilating the dining saloons. Eighty-six nine-and-one-half-inch trunnion fans are installed in the first-class staterooms. The laundry installation is driven by a five-horse-power enclosed motor. A passenger elevator serving the four passenger decks is driven by an eight-horse-power enclosed Siemens motor. There is also an electrically operated hoist for raising provisions from the refrigerating chambers. The galleys and scullcries are equipped with eight motors for spit-turning, knife-grinding, potato-peeling, bread-kneading, boot-cleaning and dish-washing. There are also an electrically driven bacon-cutting contrivance, electrically heated radiators, ovens, hot plates and irons, and the barber shop is fitted up with electrically driven hair brushes and fans in connection with the hair-drying apparatus. A very complete system of electric bells keeps the principal officers in close touch by means of an intercommunicating telephone system.—*Abstracted from Electrical Engineering (London), September 3.*

An Electrical Farm at the Electrical Exposition in Marseilles.

A model electrical farm at the electrical exposition in Marseilles is described by J. A. Montpellier. There is great scarcity of labor in the agricultural districts of France on account of emigration to the cities, but it is here shown how electricity can be made to perform all the arduous work on the farm, thus replacing human labor and remedying the existing evil. The modernized farm, which covers a surface of 800 square metres, is one of the most interesting attractions at the exposition, all the buildings of a typical farm being faithfully reproduced. The dwelling is equipped electrically throughout; there is an electric cooking stove in the kitchen simpler than that in the modern villa; an electric pump supplies ozonized water; there is an electric bread-kneader and an electric oven in the bakery; the laundry is furnished with a special pump, electric wash machines and irons; in the winter an electric fan supplies heated air to all the rooms, and it may be used to supply air cooled by ice in the summer. In the yard are a centrifugal pump installed over a well and driven by a small motor; plows, thrashing machines, huskers, winnowers, etc.; everything in full operation. The wine-cellar equipment is remarkable. It has a wine pump, grape-picker, beater and press, all operated electrically. For the manufacture of olive oil special electrically driven machinery is provided, such as presses, crushers, pumps, filters, etc. In the poultry house there is a bone-crusher, herb-cutter, electric brooders and breeders. The cowhouse contains a carrot-cutter, grain-crusher, oil-cake mill, root-cutter, as well as special apparatus for milking the cows. The dairy is furnished with the most modern utensils, cream separators, beaters and churns, manufacturing butter and cheese in view of the public. A pump and ice-making machine complete the outfit. In the stable an electric straw-cutter has been installed and also electric shears for shearing sheep. Bad odors in stables need no longer exist. Their disinfection and sanitation are efficiently effected by ozonized air produced by a special ozonizer. A shop containing a forge with an electric blower, an electrically driven band-saw, grindstone and other tools completes the installation of the farm. The vegetable garden has also received attention, for by means of electricity intensified cultivation may be practiced, so that it will be possible to obtain in winter strawberries, tomatoes and other early vegetables.—*Translated and abstracted from L'Electricien (Paris), August 29.*

The Manufacture of Carbide of Calcium.

A short history of this industry in Europe is here given by E. Rosenthal. It is well known that the experiments of Moissan and Wilson gave birth to this industry. The simplicity of the method of obtaining carbide of calcium in an electric furnace, namely, the treatment of a given mixture of lime and coke by an electric arc, gave rise to the crisis in 1900. In France, where the patents of Bulier were upheld, those factories that had been equipped for the manufacture of carbide were obliged to utilize their water power in other ways. But gradually, in France as in other countries, the factories formed combinations and thus became stronger; the methods of operation were improved, and if in 1900 all the factories were in the same position technically, this is no longer the case to-day. Furthermore, the German and French markets are regulated by two selling syndicates, of which most of the factories are members. The purely economic evolution of the carbide industry is not dealt with, the author discussing in this article the technical methods and various furnaces. The first furnaces were of circular or square section with a very heavy sheet-iron wall, which was covered inside by a thick layer of compact carbide. A square carbon electrode (forty to sixty

centimetres square and 1.8 to two metres long) was suspended inside of the furnace and connected by thin copper sheets to one of the poles of a generator or transformer, while the other pole was connected to the graphite crucible. The intermediate space was filled with the material to be treated, a mixture of lime and coke, which was transformed into carbide by the heat of the arc. The carbide was allowed to cool in the crucible and then removed in the shape of a cone. A typical installation of that time utilizing 800 horse-power contained eighteen furnaces, of which twelve were operated simultaneously. Each furnace consumed 2,000 to 2,500 amperes, and the operation lasted from two and one-half to three hours. The mass of carbide was allowed to cool for about one and one-half hours, and it took one-half hour to recharge the furnaces. To manufacture a ton of carbide required, at that time, about 750 kilogrammes of coke, 1,000 to 1,100 kilogrammes of lime, and the consumption of the electrode did not exceed thirty kilogrammes. To obtain good results it was necessary to use coke containing few cinders and lime containing neither phosphor nor sulphur. Besides this, it was of advantage to use the raw material in small pieces or pulverized, as its fusion is thereby hastened. The Compagnie Electrometallurgique patented in 1889 a type of furnace meeting these conditions. The method of allowing the carbide to cool in the furnace, which results in a great loss of heat and a rather low output, was soon followed by the continuous operation of a closed furnace. An American, L. H. Hartenstein, even obtained a patent on this process. The material to be treated surrounded the entire extremity of the movable electrode and covered the arc during the whole operation. At intervals varying from fifty minutes to two hours, according to the work and the type of furnace used, the carbide was made to flow off into ingot molds. In this manner the consumption of the electrodes and the cost of production in general were greatly reduced. The efforts of manufacturers were directed toward perfecting details of the furnace and all phases of the process. Instead of suspending the electrodes from clamps or bolts, clamps with water circulation were invented, which at the same time permitted the electrodes to descend in the measure that they were consumed, and thus only a part of the electrode was traversed by the current and exposed to the direct action of the furnace. The furnaces were made larger and of different forms. In 1900 a furnace with two suspended and movable electrodes was patented by the Société Metallurgique of Froges. This furnace was a double one with two arcs in series, the tension of which could be regulated. Gin and Leleux invented similar arrangements and applied them in their installations. In 1904 Keller took out a patent on a furnace having several fusion chambers with electrodes connected by channels to a common central crucible, where the fused masses accumulated. Morani proposed a furnace with inclined fixed electrodes placed opposite each other so as to form two walls, the distance between which could be varied. Between them was placed an auxiliary electrode not in the electric circuit and serving merely to allow the arc to pass between the fixed electrodes. He generalized this arrangement and applied it to furnaces operated by three-phase current. Finally, the Compagnie Continentale d'Electricite of Glaris and its manager, M. Lanhoffer, obtained a patent on a method of manufacturing calcium carbide that deserves special mention. In view of the two phases of the process that take place in the furnace—the phase of transformation proper and the phase of fusion—M. Lanhoffer utilizes the furnace with two electrodes and separates the two phases which succeed each other in the same furnace, but are simultaneous in two furnaces connected together. An arc is formed between the crucible and the electrode and the mixture filled in, which is transformed into carbide. This carbide accumulates in the crucible in the form of a pasty mass, with which the electrode is gradually brought in contact. The current then acquires a very great intensity and its voltage is reduced to the value necessitated by the resistance of the carbide and other parts of the circuit. In this manner the carbide is fused very rapidly and is allowed to flow off. The two furnaces being in series, the phase of reduced tension or fusion in one furnace may be made to coincide with the phase of high tension or transformation in the other furnace. It is only necessary to lower the electrode in one and raise it in the other; then the flowing off alternates in the two furnaces and the process is entirely continuous. These furnaces are now in use in a number of factories. The electrode consumption is only ten to twelve kilogrammes per ton of carbide, and the production seven to eight tons per 1,000 horse-power in twenty-four hours. L. H. Hartenstein has recently obtained a patent on a three-stage furnace, in which the calcination of the lime, the mixture of lime and coke, the treatment of the mixture by the arc and its transformation into carbide are effected at the same time.—*Translated and abstracted from La Lumiére Électrique (Paris), August 29.*

Interpole Traction Motors.

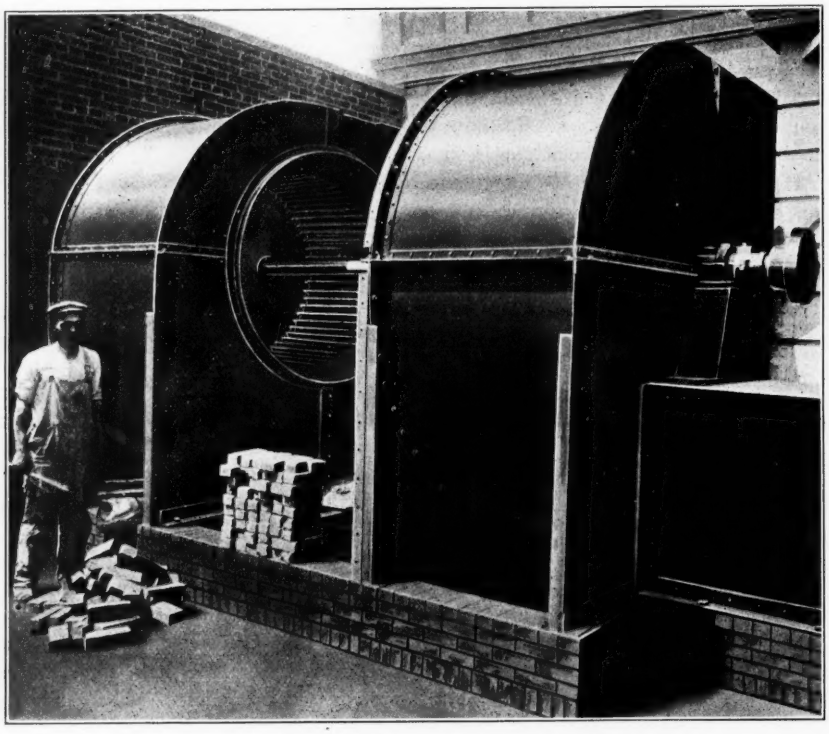
Dick, Kerr & Company have developed a series of interpole motors particularly suitable for tramway systems where extensive use is made of electric braking, and in any circumstances where the duty is more than ordinarily heavy. In some cases the motors will stand as much as 100 per cent overload without injury. The field frame is made in the usual form, of two bowl-shaped castings of soft steel of high permeability, thereby securing the smallest possible weight. The two halves are fitted together with a carefully machined joint to insure a good magnetic circuit and to make the frame both watertight and dustproof. The lower part of the frame is hinged to the upper half, permitting the lower field coils to be easily inspected and cleaned. Each armature bearing box is contained in a separate solid casting independent of the motor frame altogether, being held in position in the main motor frame by a tongued and grooved joint and firmly fixed by studs. The armature can therefore be lowered with the bottom half for inspection, or can be retained in position in the top half, as may be desired. It can further be removed from the main shell with its bearing boxes complete if occasion requires it. The main pole-pieces are made up of laminated sheet-steel punchings riveted together, and are bolted to the inner surface of the frame. The pole-pieces are interchangeable. Special arrangements are made for supporting the main field coils, two flat steel springs, each capable of exerting a pressure of about 400 pounds, being inserted between the field coil and the shell. The coils are held in place by the pole shoes themselves and brass washers which cover the surface of the coil. The interpoles are of solid steel, situated symmetrically between the main poles, and fixed in position by rivets. The interpole field coils are clamped in position by independent screws. Especially good ventilation of the armature is secured by means of the fanning action of the connections between the armature coils and the commutator bars. These connections are made of thin, flat copper strips, which, when the armature rotates, act as fan vanes and draw a current of air through the motor. This artificially produced draft is so effective that it enables a motor to run fully twenty-five per cent cooler than would be possible otherwise.—*Abstracted from the Electrical Engineer (London), September 4.*

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

A Notable Sirocco Fan Installation.

There has just been completed on the roof of the Hotel Astor a fan installation of so unusual a character as to make it of especial interest. The installation consists of two sixty-six-inch single-inlet Sirocco fans running on the same shaft. This shaft is fourteen feet between bearings.



Sirocco Fan Installation on Roof of Hotel Astor, New York City.

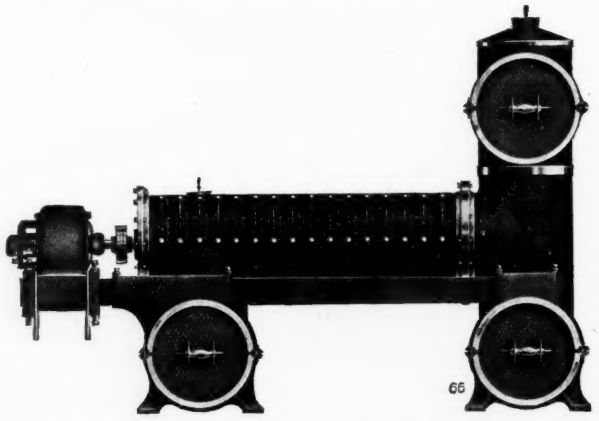
The fans draw from a common intake chamber five feet eight and one-half inches wide. They are direct-connected to a thirty-five-horse-power motor. The capacity of the fans is 50,000 cubic feet of air per minute each, against a three-quarter-inch water gauge. The flue through which the fans exhaust is of brick. The photograph showing the principal features of the installation was made prior to the bricking up of the central intake.

The light weight and small size of the Sirocco fan for the heavy duty required made it possible to mount the fans on the same shaft, thus saving not only in cost of installation but in power. The power saving is said to amount to twenty-five per cent.

Electrical Cleaning.

What has been called a new science, the science of cleaning, owes its latest development and wide applicability to the electric motor. The suction method of cleaning is fast taking the place of the broom and dust-pan, which stir up the dust and allow most of it to resettle. Instead of this old-fashioned, semi-hygienic method, modern ingenuity has devised the scientific, yet simple, expedient of sucking in the dust and germs from floors, carpets, upholstery, or any other place where they may accumulate, and transferring them through tubes to a suitable receptacle, where they are collected in a condensed condition. In addition to its hygienic perfection, this method has the advantage that it is easy, and consequently cheap, to operate. The system consists of the cleaning tools, which resemble brushes; the flexible tubes and the exhausting machine, which contains the dust separator. The exhauster and dust separator can be conveniently located in the basement or cellar and connected by piping to inlets in the various rooms and halls, where the flexible connections can be made.

The fact that the exhaust collector requires power to drive it, at first limited the application of this principle to places which had convenient power plants, but with the electric motor its use has been greatly extended. At present, office buildings, theatres and residences are being extensively provided with exhaust cleaning outfits. The latest improvement in exhaust collectors has been made possible by the continuous rotary action of the electric motor. This is the application of the turbine principle to the exhauster. The accompanying view shows one of these turbine exhausters driven by a form L motor, built by the Crocker-Wheeler Company, Ampere, N. J. The turbine has only two bearings and, in addition, the automatic dust extractor is an integral part of the cleaner and no power is wasted in drawing the air through any screens or other retarding mediums before it passes



Electrically Driven Turbine Dust-Exhauster.

through the machine. When electrically driven the apparatus can not be disabled by freezing, as may be the case when the dust-laden air current has to pass through a humidifier or where the power is obtained from steam.

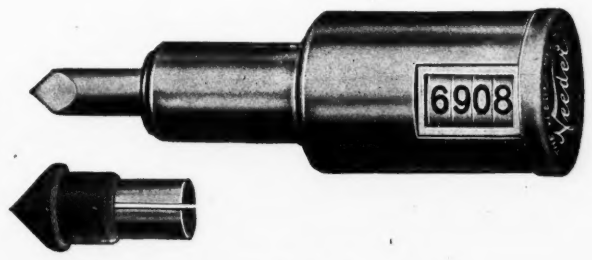
The cleaning tools used with this system have large orifices so that they will suck not only the dust but tacks, pins and scraps of paper as well.

The machine shown in the illustration is one of large size. The Crocker-Wheeler Company has been for some time supplying motors for exhausters of all sizes for use in various kinds and sizes of buildings.

Speed Counters.

The difficulty which has been encountered in obtaining accurately the number of revolutions of a generator or motor will be readily overcome by the use of a new speed counter put on the market by the Veeder Manufacturing Company, of Hartford, Ct. This instrument is shown very clearly in the accompanying illustration. It consists of a revolution counter which is operated through a clutch, the two jaws of this clutch being held apart by a helical spring when the counter is not in use.

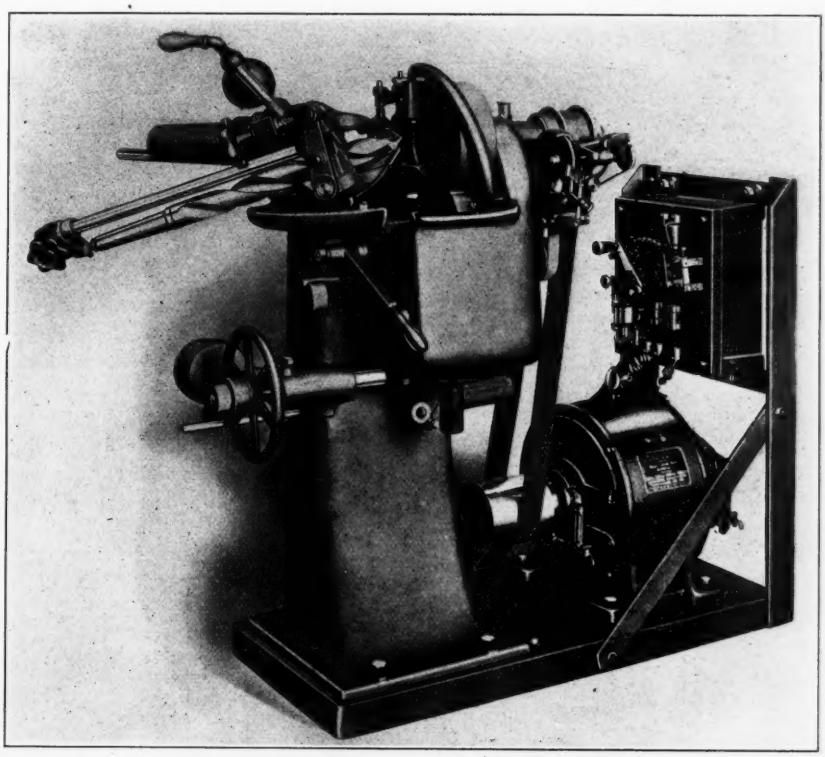
The counter is used by placing its point against the shaft the speed of which is to be measured. So long as it is held with a light pressure, the clutch is out of engagement and the instrument does not register. A watch can be held in the other hand and at the beginning of a minute, by a slight pressure on its end, the counter is started registering. If the pressure is released at the end of a minute the counter instantly stops. The difference between the reading of the counter at the beginning and end of a minute is the revolutions per minute of the shaft.



SPEED COUNTER WITH INSULATED TIP.

No arrangement is provided for setting the register back to zero; this operation taking more time than is necessary to set down the two readings of the counter and find the difference between them. The register is direct-reading, having all the figures in line; this prevents mistakes in reading the instrument.

This speed counter is peculiarly adapted to electrical work because it is not affected by magnetism and also because an insulating tip is provided which prevents any short-circuit through the instrument, and does away with the necessity of using a stop-watch.



A MOTOR-DRIVEN SELLERS DRILL GRINDER.

Drill Grinding by Machinery.

It is a well-recognized fact that there is a theoretically correct shape for a drill, whether of the flat or twist type, in order to obtain the maximum amount of work from the drill. It is also fully admitted that hand grinding can not give this best shape and for this reason more power is required by the hand-ground drill than is necessary. In addition to this, a drill incorrectly ground will not bore a uniform hole to size.

Drills correctly ground and pointed will not only drill to size with minimum power, but when straight they will wear the drill press less than if incorrectly ground or out of true. In the latter case the force required to hold the drill steady brings a strain on the drill press which causes the bearings of the spindle to wear.

The drill-grinding machine illustrated herewith is manufactured by William Sellers & Company, and is equipped with a standard Westinghouse motor of two-horse-power capacity. The entire outfit is self-contained with starting switch and motor complete. The grinder is suitable for any type of double-tip drills, varying from five-sixteenths inch to three inches in diameter.

The grinding of the tips is done on the face of the stone, or grinding wheel, which insures a correct surface as the drill is moved over the entire face of the wheel. By a special device the correct pointing of the drill is secured.

An interesting feature is the method adopted for providing an ample supply of water at the grinding surface. The wheel proper is protected by a cover at all points except where the drill comes in contact with it. On the cover there is an adjustable nozzle through which water is

delivered in an abundant flow to both drill and wheel without splash or waste. The water is moved by a small centrifugal pump driven from the main motor.

The entire equipment is very simple, so that a skilled workman is not required; any man of ordinary care can operate the machine with perfect satisfaction.

The application of the motor to this grinder permits the machine to be located in the shop at any point desired, without reference to shafting or belts. It secures the maximum economy of driving power, inasmuch as the entire outfit may be stopped whenever not in actual use.

Milling Machine.

Many direct, as well as indirect, advantages resulting from driving machine tools by electric motors have resulted in a gradual improvement in the methods of attaching the motors.

In many instances the characteristics of the motors have been such that modifications could be made in the tools to such an extent that they were considerably simplified, as well as their productive capacity increased, by considering the motor and the tool as a unit in making the original designs. These applications may be contrasted with the somewhat older method of applying a motor to a standard belt-driven tool.

As direct and alternating-current motors have characteristics of a different nature the method of applying these two different types of motors is materially different. For that class of service requiring a variable cutting speed, the direct-current adjustable-speed motor is especially well adapted. A good example of this is shown in Fig. 1, where a fifty-horse-power Westinghouse motor is shown applied to a heavy milling machine manufactured by the Ingersoll Milling Machine Company. The motor has an initial speed variation of from 500 to 1,000 revolutions per minute, the speed being controlled by means of a drum-type controller not shown in the illustration, mounted at a point convenient to the operator.

In addition to the speed variation obtained in the motor, there are change gears, giving speed variations of about seven to thirty-five revolutions per minute, and the feed may be varied from one-half to fourteen inches, as may be required. The miller is particularly adapted to such heavy work as paneling locomotive side rods—which is perhaps as heavy work as such machines are called upon to do. The tool is powerful enough to remove forty-five cubic inches of steel per minute when taking a slabbing cut.

With the alternating-current equipment, as shown in Fig. 2, the speed of the motor is fixed and it is necessary to supply a suitable run of gearing, which may be operated by a lever to obtain the required changes in speed. As before, the speed range runs from seven to thirty-five revolutions per minute of the tool.

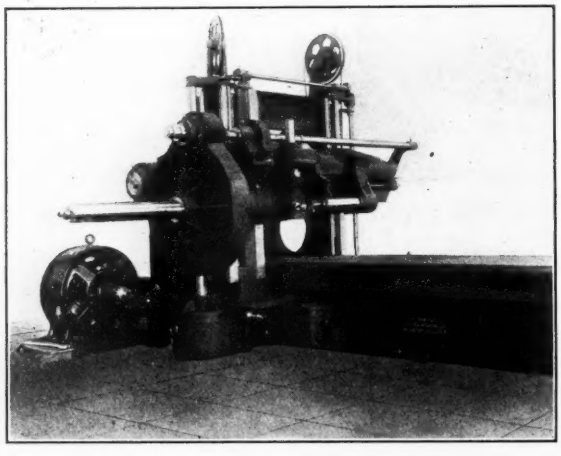


Fig. 1.—Milling Machine with Direct-Current Motor.

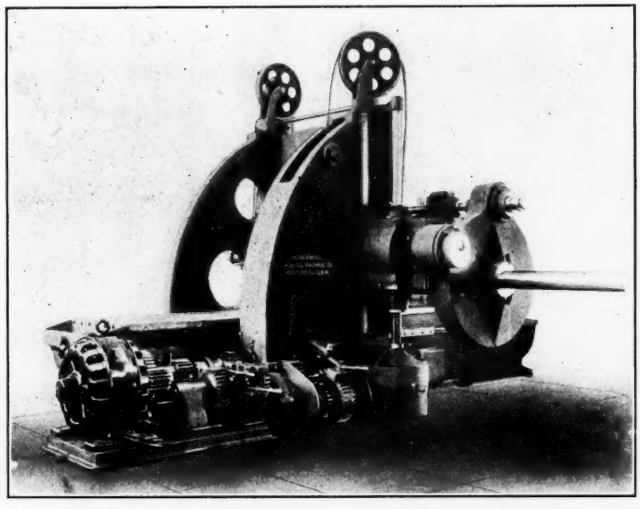


Fig. 2.—Milling Machine with Alternating-Current Motor and Gear.

Famatina Development Corporation.

The Famatina Development Corporation, which is interested in the development of copper mines near Chilecite, Argentine, is installing a hydroelectric plant, the generating equipment for which consists of two 200-kilowatt, 240-volt, revolving field generators with direct-connected exciters, together with a suitable switchboard and transformers for stepping the voltage up to 13,200 volts. The generators are belt connected to a line shaft driven by two four-foot Pelton water-wheels capable of developing 630 horse-power at 300 revolutions per minute. The head is 230 feet, the pipe line being 6,661 feet in length.

In addition to the generating station there are also two substations, one located at the smelter a short distance from the generating station and the other at the mines. The power in the smelter is taken direct at the generator voltage, while that in the mine is stepped down from 13,200 to 240 volts. In addition to the apparatus mentioned above, the General Electric Company also supplied several induction motors of various sizes for use both at the mines and at the smelter.

This installation is comparatively small, but is interesting from the fact that a twenty-mile transmission line will be erected from their generating station to the mines for transmitting only 100 horse-power (ultimately 200 horse-power), this comparatively large expenditure probably being due to the scarcity of fuel.

New German Cable Company.

The German-South American Telegraph Company has been founded in Berlin, Germany, with a capital of 4,000,000 marks. This capitalization will be increased from time to time as the business progresses. It has been stipulated that two-thirds of the board of directors must be of German nationality and must reside in Germany. The electrical manufacturing firm of Felten, Guilleaume & Lahmeyer, which originally obtained the concession and passed it on to the new company, will supply and lay down the new cable, and negotiations are under way with the Brazilian Government in regard to securing a landing place.

A Heavy Wire Lamp Guard.

The accompanying illustration shows a heavy wire lamp guard which has been placed on the market by Herbert T. Foster, of Worcester, Mass. This guard is firmly attached to the socket, and does not touch the lamp nor depend upon it

HEAVY WIRE LAMP GUARD.

for support in any way. The same guard can be used with either a sixteen-candle-power or a thirty-two-candle-power lamp, and a lamp may be removed and a new one inserted without the guard being taken from the socket.

The advantages of this guard make it especially desirable for general factory and shop use, car-barns or any other place where a lamp is required to be protected.

A Thoroughly Insulated Incandescent Lamp Guard.

Quite recently there has been a good deal of prominence given to the possible danger which may exist if a metal lamp

FIBRE LAMP GUARD.

guard should become charged from a high-tension circuit through a defective cable or broken-down insulation, rendering the guard alive. A few weeks ago announcement was made of death by shock to a young man who had carelessly taken up a wire lamp guard which was afterward found to be defectively insulated.

The accompanying illustration shows a lamp guard made by the Benjamin Electric Manufacturing Company, Chicago, Ill., which, because of its construction and the material of which it is made, eliminates the possibility of injury from shock. The handle is made of well-seasoned and thoroughly insulated wood, and the guard proper is made of narrow strips of insulated fibre. The strips are placed radially to the lamp and cut off very little of the illumination from the light source.

First Annual Report, Public Service Commission, Second District, State of New York.

The first annual report, for the year 1907, of the Public Service Commission for the Second District, State of New York, has been issued. The commission took office and entered upon the discharge of the duties imposed upon it by law on July 1, 1907. The Second District commission has jurisdiction over all the counties of New York state except New York, Kings, Queens and Richmond. There have been created six separate divisions of the commission, as follows: Division of Light, Heat and Power; Division of Railroad Engineering and Inspection; Division of Statistics and Accounts; Division of Traffic; Division of Tariffs; General Office.

The work assigned to the Division of Light, Heat and Power is the supervision of all gas corporations, electrical corporations, the inspection and testing of gas and inspection and testing of gas meters, the inspection and testing of electric meters, the supervision of municipal electric plants, so far as power is given to the commission.

The Division of Railroad Engineering and Inspection includes the inspection and supervision of the physical properties of both steam and electric railroads.

This report covers the period for the six months ended December 31, 1907. On that date there were seventy-one electric railroads operating in the second district. These roads owned and operated 1,510 miles of track and leased or controlled 159 miles. There were 171 electrical companies and fifty corporations supplying both gas and electricity. For the inspection of electric meters the second district has been divided into four electric-meter inspection districts, with respective headquarters at Yonkers, Albany, Utica and Rochester. An inspector of electric meters, appointed from a list of eligibles furnished by the state Civil Service Commission, is stationed in each district, under the supervision of a chief inspector at Albany.

Vol. i of the report contains, in addition to the matter which is summarized below, appendices comprising the miscellaneous orders which have been issued by the commission during the period covered by the report. There is a general index and an index of the report of the Board of Railroad Commissioners. Vol. ii contains the abstracts of reports of corporations. It includes assets and liabilities, cost of road and equipment with distribution of cost, securities, funded debt, dividend-paying stock, non-dividend-paying corporations, road and equipment, miles of road operated, locomotives and cars in service, income with deductions and revenue from operation; operating expenses, distributed as to maintenance of way, etc.; freight operations, classification of commodities, passengers carried, monthly wages of employés, highway and railroad crossings and casualties of steam railroad corporations and electric railroad corporations, and gas and electrical companies. A supplement to the report comprises two magnificent maps showing in colors the steam railroads and the electric railroads operated in the state of New York.

The Kansas Gas, Water, Electric Light and Street Railway Association.

The eleventh annual meeting of the Kansas Gas, Water, Electric Light and Street Railway Association will be held at Pittsburg, Kan., October 8 and 9. Headquarters will be established at the Stilwell Hotel. The programme has been announced as follows: President's address, C. L. Brown, Abilene, Kan.; "Street Lighting—Arc and Series Tungsten," N. R. Birge, General Electric Company, Schenectady, N. Y.; "Electrical Jobbers," P. B. Chaney, Monarch Electric Company, Kansas City, Mo.; "The Correct Rate to Be Charged by Central Stations," W. A. Scothorn, Hutchinson, Kan.; "Commercial Insulation of Wire," F. H. Dimick, International Lecture Institute, New York, illustrated by lantern slides; "Finances of the Light Business," H. V. Forest, superintendent Winfield Electric Light Company; "Steam Turbines," C. R. Mackay, manager Toledo Railway and Light Company, Toledo, Ohio; "Incandescent Lamps," S. E. Doane, chief engineer National Electric Lamp Association, Cleveland, Ohio; "Our System of Bookkeeping and Records," Dow R. Guinn, Pittsburg Water Supply Company.

Current Electrical News

DOMESTIC AND EXPORT.

NEW WIRELESS TELEGRAPH COMPANY—Articles of incorporation have been issued to the Southern Wireless Telegraph Company, which is capitalized at $1,000,000, and which will have its headquarters at Little Rock, Ark. The company proposes to install a station and to place Little Rock in connection with eighteen other stations in Arkansas, Louisiana, Mississippi and Oklahoma. It is proposed to have the new station at Little Rock in operation in a short time and to locate the other stations as soon thereafter as possible. George A. Parker is president of the company, Harry C. Hale secretary and R. T. Balch treasurer.

WASHINGTON ELECTRIC ROAD INCORPORATED — The Spokane, Columbia & Western Railway Company is the name of the new electric and steam road which the Graves interests will build from Spokane into the Big Bend country. Articles of incorporation for the new railroad have been filed at the county courthouse, the capital stock being $3,000,000. Jay P. Graves's name does not appear as one of the incorporators. These are: Clyde M. Graves, Waldo G. Paine, W. G. Davidson, H. B. Ferris and Will G. Graves. All are connected with the Inland Empire system. The road will run from Spokane to the mouth of the Spokane River, seventy-five miles. Surveyors have been in the field for several weeks. Ample power will be available at the new power plant owned by the Graves interests at Nine Mile to operate the new line and the present lines of the Inland Empire system.

NORTHERN COLORADO POWER COMPANY TO ISSUE BONDS —The Northern Colorado Power Company has decided to increase its bond issue from $3,000,000 to $6,000,000, to provide money for proposed extensions to its transmission lines and to increase the capacity of its power plant at Lafayette. It was provided that the outstanding $3,000,000 be retired, and the present holders receive a like amount of the new bonds. The additional $3,000,000 in bonds will be utilized for construction work. Transmission lines will be extended from Greeley to Lafayette by way of Brighton. President Barker is planning to supply a large amount of power for irrigation purposes. There is, he says, a growing demand for electricity for pumping water on farms and the company is preparing to meet the demand. Scores of wells are being sunk on farms, and water will be pumped for irrigation.

NEW INCORPORATIONS.

ALBANY, N. Y.—Valatie Telephone Company. Valatie. $10,000. Incorporators: Edwin D. Howe, Wilson Miller, Valatie.

CHICAGO, ILL.—Traction Lighting Company. $100,000. Incorporators: Fred H. Atwood, Charles O. Loucks and Henry Tupper.

SPRINGFIELD, ILL.—Saline County Traction Company. $5,000. To build an electric line from Eldorado to Carriers Mills in Saline county.

SPRINGFIELD, ILL.—Roanoke Telephone Company, Roanoke. $2,000. Incorporators: P. W. Kennell, E. W. Rediger and J. J. Beer, Jr.

DOVER, DEL.—Safety Electric Railway Company. $50,000. Incorporators: A. H. Angle, A. Barbeel, Philadelphia, Pa.; W. I. N. Lefland, Dover.

BOISE, IDA.—Canyon Light, Power and Water Company, of Shoshone County. $250,000. Incorporators: Ellis L. Hale, W. R. Miller and L. C. Wilson.

NASHVILLE, TENN.—Great Falls Power Company, Davidson County. Amended charter, increasing the capital stock from $20,000 to $625,000.

AUGUSTA, ME.—Tuolumne River Power Company. $500,000. Officers: President, Charles D. Shaw, of Greenville; treasurer, William M. Shaw, of Greenville.

LOS ANGELES, CAL.—El Monte Home Telephone Company. $25,000. Incorporators: J. S. Killian, F. P. Sappington, Edgar O. Fawcett, I. Kauffman and A. F. Snell.

ALBANY, N. Y.—Westchester County Automatic Telephone Company. $100,000. Incorporators: Frederick Hughes, Helen Degnon, Joseph L. Abrahams, Yonkers, and others.

CLEVELAND, OHIO—International Independent Telephone Company. $10,000. Incorporators: C. Y. McVey, W. H. Hillhouse, J. C. Boush, W. H. Sheppard, W. E. Cary, Jr.

TRENTON, N. J.—Haytian Electric Company, Jersey City. $100,000. Incorporators: L. M. Arthur, S. H. Parsons and J. L. Egan. To generate electric current for heat, power and light.

BEEBE, ARK.—Beebe Light and Power Company. $10,000. Incorporators: J. S. Smith, president; M. Strickland, vice-president; E. Roberts, secretary and treasurer; G. H. Hills and F. D. Worthington.

GRAFTON, W. VA.—Oakdale Telephone Company, of Oakdale, Mercer County, W. Va. To construct and operate a telephone line. $1,000. Incorporators: J. R. Boyd and fifteen others of Mercer County.

DENVER, COL.—Naturita Valley Rural Telephone Company. $1,500. Incorporators: G. A. Akers, H. H. Ross, Henry Tamm, Roger L. Williams, George W. Hook, Arthur Priestley and K. B. Northrup.

OAKLAND, CAL.—Jahnke Aerial Telephone Company. $200,000. Directors: Albert Jahnke, John T. Geraty, Frank J. Golden, L. M. Sherwood, C. H. Halzborn, W. L. Harshbarger, W. R. Anderson and A. Kovanik.

JERSEY CITY, N. J.—The Billings Mutual Telephone Company, Jersey City. To operate public telephone exchanges and systems. $500,000. Incorporators: P. B. Moss, G. M. Hays, J. N. Perry, Billings, Mont.; S. S. Moore, Jersey City.

FORT SMITH, ARK.—Fort Smith-Oklahoma Light and Traction Company. $30,000. Formed for the purpose of owning and operating in Arkansas and Oklahoma, to deal in real estate, natural and artificial gas, etc. Incorporators: P. K. Reiss, I. S. Lowrey, E. H. Thomas, Rudolph Ney and C. P. Wilson. Mr. Reiss is president; Mr. Lowrey, vice-president; Mr. Thomas, secretary, and Mr. Ney, treasurer.

HARRISBURG, PA.—Kutztown Rural Telephone and Telegraph Company. $10,000. To operate in Berks and Lehigh counties, touching Kutztown, New Tripoli, Krumsville, Weaverville, Kingston, Steinsville, Wannamaker's, Lynnport, Roberts Corners, Werley's Corners, Sweitzer, Lynn Valley, Clausville, Guthsville, Maxatawney, Park Avenue and Monterey, all in Berks and Lehigh counties. Treasurer, Charles A. Stein, of Kutztown.

NEW MANUFACTURING COMPANIES.

NEW YORK, N. Y.—The International Wire Company, with a capital stock of $250,000, has been incorporated to act as contracting, mechanical and electrical engineer, and to manufacture cars, trucks, etc. The incorporators are A. A. Harrison, J. A. Walsh, Brooklyn; E. H. Cook, Wilkes-Barre, Pa.

ALBANY, N. Y.—The Nonpareil Electrical Manufacturing Company has been chartered with a capital of $50,000 to manufacture and deal in electrical supplies. The headquarters of the company will be in New York city. The incorporators are C. S. Shuman, A. F. Braatz, New York city, and E. M. Speer, New Jersey.

PERSONAL MENTION.

MR. E. H. BURLINGAME has resigned as manager of the Oelwein Light, Heat and Power Company, Oelwein, Iowa, to accept the position of superintendent of the People's Gas and Electric Company, of Chillicothe, Mo.

MR. J. H. CLUNE, Washington, Pa., has been appointed superintendent of the Butler division of the Bell Telephone Company, succeeding H. A. Trax. Mr. Trax has been transferred to the office of the general superintendent at Pittsburg.

MR. W. A. CATTELL, president of the Petaluma & Santa Rosa Railway Company, Petaluma, Cal., has tendered his resignation, to take effect October 1. He will be succeeded by E. M. Van Frank, general manager of the company. The pressure of private business was given as the reason for Mr. Cattell's retirement.

MR. GEORGE N. TIDD, general manager of the Scranton (Pa.) Electric Company has been made managing director of the Municipal Steam Heating Company, of Syracuse, N. Y. Both Scranton and Syracuse capital is interested in the company. This appointment will not interfere with Mr. Tidd's present connection.

MR. CUSTER L. FARNSWORTH, who for five years has been superintendent of the electric department of the Ludlow Manufacturing Company, Ludlow, Mass., has accepted the position of superintendent of construction with the Fitchburg (Mass.) Electric Lighting Company, and begins his work there October 1.

MR. C. E. F. AHLM, Cleveland, Ohio, has been retained as consulting engineer by the Board of Public Service of Lima, Ohio, in connection with the municipal electric lighting plant to be built in that city. The plant will consist of one 200-kilowatt and one 300-kilowatt units, 2,300-volt, sixty-cycle, three-phase, direct-connected to compound engines, and $80,000 has been appropriated for the work, which will begin at once.

MR. L. E. FISHER, of Danville, Ill., has tendered his resignation to President W. B. McKinley, of the Illinois Traction System, effective on January 1, 1909. Mr. Fisher will be succeeded as general manager of the McKinley system by H. E. Chubbuck, of Ottawa, Ill. Mr. Fisher entered the service of the Illinois Traction system in 1901, previous to which he had been superintendent for a short time of the electric light and power company at Paris, Ill. Mr. Fisher will engage in the railroad construction business.

MR. HENRY J. PIERCE, president of the International Railway Company, Buffalo, N. Y., announces that he will resign from the presidency of the company at the annual meeting on September 29, and that he will be succeeded by Thomas Penny, of the law firm of Norton, Penny & Sears. Mr. Pierce intends to devote all his time to the affairs of the Amsterdam corporation formed last May by himself and W. J. Wilgus, former vice-president of the New York Central & Hudson River Railroad Company. The company is engaged in the contracting and engineering business in New York.

MR. C. L. DE MURALT has been reappointed professor of electrical engineering at the University of Michigan for the coming year. During the winter season Professor Muralt will devote his attention to the consideration of the more general aspects of applied electricity. The course of lectures will include the discussion of: (1) The characteristics and application of alternating and continuous-current motors; (2) the design, construction and operation of electric plants; (3) the principles and methods of transmitting, distributing and controlling alternating currents; (4) the calculation and operation of electric railways, and (5) the management of electric properties, with special references to the commercial aspects of electrical engineering.

MR. GEORGE H. GUY, the well-known litterateur and secretary of the New York Electrical Society, is the author of a most interesting article entitled "Real Navigation of the Air," in the September issue of the *American Review of Reviews*. Mr. Guy has been a close student of the subject of ballooning and aeronautics for many years, and has enjoyed the friendship and confidence of the prominent aeronauts of the day. He is in possession of probably the finest collection of data on this subject, and his facile pen has turned to good account in this article the essential information which the world is so anxious at the present time to secure concerning navigation of the air. The article is not simply descriptive, as Mr. Guy draws upon his knowledge of the subject in interpolating a good deal of philosophy as to the possibilities of the future development of the science of aerial navigation.

OBITUARY NOTE.

MR. ALBERT P. SEYMOUR, for many years active in the firm of Pass & Seymour, Incorporated, manufacturers of electrical specialties at Solvay, N. Y., died last week at his residence in Monrovia, Cal. He retired from the business in 1906 on account of failing health, disposing largely of his interests, and had since resided in Monrovia. A year ago he went to Syracuse, N. Y., on a visit, and on October 5 was taken ill at the residence of J. Brewster Gere, where he was confined to his bed until about July 1 of this year. He then returned to California. Mr. Seymour was actively engaged in business in Syracuse for many years. He was connected for some time with the Electric Light and Power Company, now the Syracuse Lighting Company. Later he became a member of the firm of Pass & Seymour, which became Pass & Seymour, Incorporated. He is survived by Mrs. Emily Seymour, his widow; Albert P. Seymour, of Monrovia, his son; and Mrs. T. S. Johnson, his sister, and his sister-in-law, Mrs. A. H. Seymour, both of Syracuse.

TELEPHONE AND TELEGRAPH.

QUINCY, ILL.—Articles of incorporation have been filed for the Fall Creek and Payson Telephone Company, with headquarters at Fall Creek.

SANDY CREEK, N. Y.—H. C. White, who owns the Pillar Point telephone line, is arranging to give Dexter, Brownville and Watertown complete local lines with Watertown connections.

EMAUS, PA.—The town council has given permission to the Pennsylvania Telephone Company to build its line through the borough. The company is arranging for the extension of a line to Carbondale, the town council having granted the necessary franchise.

WILKES-BARRE, PA.—The Pennsylvania Telephone Company has awarded contracts for the necessary construction material in connection with the placing under ground of its wires in certain sections of the city, in accordance with an ordinance recently passed.

TREMONT, ILL.—The village board of Tremont has granted to the Farmers' Mutual Telephone Company a franchise to run its line though the village. The franchise runs for twenty years. The company is pushing the work of construction on the new line, which is being built south from Tremont.

DUBUQUE, IOWA—At the annual meetings of both the directors and the stockholders of the Interstate Telephone Company all the officers and directors were re-elected with the exception of Director J. J. Kahn, of Elkader, who was succeeded by George Kreibs, of Elkport. The officers and directors are as follows: President, J. M. Dunn, Earlville, Iowa; vice-president, R. W. Gadsen, Dyersville, Iowa; treasurer, C. M. Laxson, Earlville, Iowa; secretary, J. H. Denkhoff, Dyersville, Iowa. Directors: George Kreibs, Elkport; V. H. Stevens, Dubuque, and J. L. Paine, Fayette, Iowa.

HARTFORD, CT.—With the object of bringing about a general improvement in service conditions, the Southern New England Telephone Company has planned to place in effect, on October 1, in the cities of Bridgeport, Hartford, New Haven and Waterbury, certain adjustments of its residence rates which, it is believed, will lead to a more general adoption of single or individual lines by subscribers and thereby tend to eliminate the existing delays resulting from the large usage of party-line service. In substance, the company's plan contemplates the provision of single-line domestic service in these four cities at the rate of $36 per annum. This rate will be applied to those existing subscribers who are at present paying net charges of $40 per annum in Waterbury and $48 per annum in Bridgeport, Hartford and New Haven for a domestic single-line service and will be offered to new subscribers desiring such service. The two-party line service at present furnished in Bridgeport, Hartford and New Haven at the rate of $36 per annum will be discontinued, and the existing subscribers to domestic service at that rate will be provided with single lines at the same rate.

ELECTRIC LIGHTING.

DUNKIRK, N. Y.—The water board has awarded to the Westinghouse Company the contract for a twenty-five arc-lamp equipment.

ELLWOOD CITY, PA.—The Pennsylvania Power Company is to rebuild its plant which was destroyed by fire several months ago.

ROGERS, ARK.—W. R. Felker has sold his electric light and water plant at Rogers to W. S. Merkle, of St. Louis, who has taken charge of the plant and is now operating it.

BEAVER, PA.—The citizens of College Hill Borough have voted in favor of a $15,000 bond issue, the proceeds to be used to improve the town electric light plant.

FORT GIBSON, OKLA.—The Fort Gibson ice and electric light plant has been destroyed by fire. The origin of the fire is unknown. The loss will not exceed $20,000.

CARTHAGE, N. Y.—The village board of trustees of Carthage has signed a five-year contract with the Carthage Electric Light and Power Company to light the streets at $60 a light.

HAMILTON, OHIO—Lindenwald and East Hamilton, suburbs of Hamilton, are to be lighted electrically by the municipal lighting plant. The work of extension will cost about $20,000.

FLORESVILLE, TEX.—At a meeting of the city council F. Largen asked for a thirty-year franchise in consideration for which he proposed to construct an electric light plant in Floresville.

FAIRMONT, W. VA.—A new electric light company has been formed to be known as the Independent Power and Light Company. The officers are: L. C. Wyer, president; A. H. Donnelly, secretary.

BRISTOL, VA.—The Bristol Gas and Electric Company has closed a contract for new generators, turbine engines and other machinery aggregating $50,000 in cost, to be installed in its Bristol plant.

PARIS, ILL.—At a meeting of the city council an application for a thirty-year franchise was made by a company of local business and professional men, who wish to establish a plant for gas and electric lighting and hot-water heating.

LIMA, OHIO—Judge Mathers has made permanent the temporary injunction granted preventing members of the city council from reconsidering their action in passing the ordinance providing for an $80,000 municipal electric light plant.

SCRANTON, PA.—By a deal consummated recently, the Scranton Electric Company secures control of the Standard Electric Light, Heat and Power Company, of Avoca. The Scranton company now has a chain of light companies from Pittstown to Priceburg.

VIROQUA, WIS.—Having arranged with the city for an extension of its franchise, the Viroqua Electric Lighting Company will rebuild its plant and put in an entirely new service. The plant will be enlarged so as to meet the demands of the city for years to come.

KAUKAUNA, WIS.—The Kaukauna Gas, Electric Light and Power Company, which is composed of Milwaukee capitalists, has leased the new electric power plant just completed by the Green Bay & Mississippi Canal Company, with a capacity of 2,500 horsepower.

SALTILLO, MEX.—Important changes to the street lighting system of Saltillo are being made. The entire system has been rewired and larger and improved arc lights are being installed. The large, modern electric light plant has been completed and is ready for operation.

MONTGOMERY, ALA.—The Montgomery Light and Water Power Company announces that it intends to run an entirely new transmission line from Tallassee, Ala., thirty miles from this city, to Montgomery. The expenditures which the company has planned will amount to $100,000.

BUFFALO, N. Y.—The Cataract Power and Conduit Company has made application to the Public Service Commission at Albany for permission to issue $120,000 in gold bonds. The issue is desired to cover the purchase of additional lands and the extension and improvement of the power plant.

SALT LAKE CITY, UTAH—George H. Brumhall, representing a mining company in Utah County, has filed application for rights to the waters of Santaquin creek. It is proposed to withdraw twelve second feet of water from the creek to generate 1,200 horse-power for mining machinery and lighting purposes.

TURNERS FALLS, MASS.—At a meeting of the Turners Falls fire district it was voted to accept the report of the committee on street lights and the prudential committee was instructed to draw up a five-year contract with the Franklin Electric Light Company for seventy-six incandescent lights of sixty candle-power and sixteen arc lamps.

ONTARIO, ORE.—The Interstate Light and Water Company is running a line from its power plant at Horseshoe Bend on the Payette River to Weiser and from there it will be extended to the city. Aluminum wires are used in the construction of this line, which will later be connected with the Ox Bow Tunnel plant and the line extended to Boise. Six thousand volts will be transmitted.

NORWICH, CT.—In its annual report the gas and electric commissioners show that the department has made a profit of $26,986.15 during the year ended July 31. There was an income showing an excess over cost of production of $41,286.53. From this there had to be deducted five per cent for depreciation, leaving the net earnings as given above. This is an increase of $4,300 over last year and $7,000 over that of 1906.

BIRMINGHAM, ALA.—At a meeting of the directors of the Coosa River Electric Company it was decided to amend the charter of the company so as to enlarge the scope of the corporation. The company will begin to build a dam across the river in a short time and also to construct locks at the most suitable places along the river. The aim now is to supply electric power to all parts of the state in as short a time as possible.

WAPAKONETA, OHIO—The contract for the new municipal electric light plant at New Bremen, Ohio, was divided among three of the bidders. The Western Electric Company, of Columbus, was awarded the contract for furnishing the generator at its bid of $5,500; the St. Mary's Machine Company will furnish the gas engine, and the Westinghouse Electric and Manufacturing Company will supply the switchboard and connections.

NEW ORLEANS, LA.—Announcement is made of the awarding of contracts here and in Milwaukee, Wis., for the establishment of a complete electric lighting plant for Lucedale, Miss. Gregory M. Luce is to install the plant, which will furnish lights for his large mill interests there, as well as public-service lighting. It was stated that the contracts awarded reach fully $20,000. The Hollifield Electric Company, of Mobile, was awarded the contract for wires, insulation, poles, etc.

JERSEY CITY, N. J.—The board of aldermen, sitting as a committee of the whole, received a proposed ordinance that is intended to grant a twenty-year franchise to the Mutual Benefit Electric Light and Power Company to open the streets of this city and lay conduits therein for the supplying of electricity. The ordinance was drafted to meet the objections which prompted Mayor Wittpenn last June to veto an aldermanic grant to the company, of which James M. Seymour, Jr., of Newark, is president.

GADSDEN, ALA.—At a meeting of the city council the franchise asked for by the Etowah Light and Power Company, to allow it to enter this city with its wires for the sale and distribution of light and power, was granted, with some slight modifications. The company agrees to be ready to give service within eighteen months and puts up a forfeit of $2,000 in case of failure. No provision was made in the franchise for a lower rate of charges than now obtains. The present rate is sixteen cents per kilowatt-hour.

COAL CITY, IND.—Capitalists have closed a deal for the Steiner land, at Cataract, Owen County, on which the cataract falls of Eel River are located. The tract of land embraces both the upper and lower falls, for which the company paid $150,000. It also purchased 303 acres of land from Lowery Brown and Warren Meek, for which it paid $19,000, making the total purchase price $169,000. This gives the company possession of all the land between the two falls. A dam fifty feet high and estimated to cost $150,000 will be built just above the lower falls, which will create a reservoir between the two

falls covering 600 acres. Power-houses will be erected at the lower falls and one of the greatest electric light plants in the state established. A traction line from Indianapolis will pass through Cloverdale and across the top of the dam and on to Brazil. It is said the proposed plant will be able to generate electricity enough to light every town in this part of the state.

BIDDEFORD, ME.—Active work has been begun by the Limerick Water and Electric Company, a subsidiary company of the Limerick mills, in the development of its water power at The Ledges, about three miles from Limerick village, and by January 1 it is hoped to have a power plant in operation there which will develop 600 horse-power, which will be sufficient to operate the mills of the company, and also furnish power for electric lights in Limerick village, and to operate an electric railway between Limerick and East Waterboro, the nearest railroad point.

YPSILANTI, MICH.—The city council has granted a thirty-year franchise to the Washtenaw Light and Power Company. General Manager Hemphill says that $60,000 will be expended in the construction of a plant and in the improvement of the Huron River. The ordinance provides that the needs of Ypsilanti shall be supplied with electricity developed within a radius of five miles of the city before power or light is supplied to outside cities. The rates are not to be above those in other cities of similar size. Construction will be begun this fall or early in the spring.

SALT LAKE CITY, UTAH—As a result of the purchase of its bonds by a syndicate of British capitalists, the Salt Lake Public Service Company has resumed work on the construction of its power plant in Cottonwood canyon after a shutdown of many months. J. J. Chambers, manager of the company, has severed his connection and all construction work will be under the direction of J. C. Hornung, resident engineer for the Schott Company of Chicago. It is expected application will be made to the council by the company for a renewal of the franchises to supply Salt Lake City with heat and lighting facilities. Most of the original franchises have expired since taken out.

SAN BERNARDINO, CAL.—The troubles involving the Metone Power Company, the Mountain Power Company and the Pacific Light and Power Company, which have occupied the attention of the local courts for the past four years, have been settled out of court, and notices of dismissal of action filed in the several cases. These suits were brought to settle the water rights of the various power companies in the canyon of the Santa Ana River east of this city and north of Redlands, and it is understood that a settlement was effected by reason of the sale of the property of the Mountain Power Company to the Edison Electric Company, which at the same time came to an agreement with the other companies involved. It is now announced that a large power plant will be installed as quickly as possible.

ASHEVILLE, N. C.—In the Federal Court Judge Pritchard appointed P. A. Wilcox as receiver of the Carolina Water, Light and Power Company, which has plants at Darlington and Marion, and of the Florence Light and Power Company, of Florence, all in South Carolina. Mr. Wilcox has also been named as receiver of the Rock Hill Water, Light and Power Company. Mr. Wilcox was appointed receiver of the Darlington, Marion and Florence plants on the bill in equity filed by the Real Estate Trust Company, of Philadelphia. In the case of the Carolina Water, Light and Power Company, the receiver was authorized to issue $30,000 in receiver's certificates to meet maturing obligations, and $20,000 of such certificates on account of the Florence Company. Mismanagement and financial inability to meet bond obligations are charged in each bill.

ELECTRICAL SECURITIES.

Since the bull movement was inaugurated last June there have been a good many prophesies as to its termination, and wonderment as to the real reasons underlying such a considerable improvement in prices. In many quarters it was held that the improvement was not justified by any inherent increase in values, but that it was stimulated for certain reasons by strong interests which had the market pretty well under control. Last week the reverse happened, and the sharpest break since the bull movement was inaugurated occurred, leading issues making losses extending from about four to ten points. While the break in this instance is held to be more or less due to an election scare, it is just as difficult to find any real reason for the demoralization as it was to estimate the reasons for the previous improvement. That the political situation is important no one will deny, but that it has changed materially in the last two months is difficult to prove. Trade conditions are making a slow and irregular improvement, but there is a better evidence of improvement now than there was two months ago. Money, it is true, is firm, but there appears to be an abundance of it ready for safe and sane investment. The crop outlook is certainly no worse than it has been, and it is to be expected that the decline of last week is merely a spasm, and will be checked very shortly, and things move again in a more satisfactory way.

Dividends have been declared upon the following electrical securities: Washington Water Power Company, of Spokane, Wash.; regular quarterly dividend of 1¾ per cent, payable October 1 to stock of record September 21. American Cities Railway and Light Company; regular quarterly dividend of 1½ per cent on the preferred stock, payable October 1 to stock of record September 21. Bangor (Pa.) Railway Electric Company; regular quarterly dividend of 1¼ per cent, payable October 1 to stock of record September 20. St. Joseph (Mo.) Railway, Light, Heat and Power Company; regular quarterly dividend of 1¼ per cent on the preferred stock, payable October 1 to stock of record September 15. Tri City Railway and Light Company; regular quarterly dividend of 1½ per cent, payable October 1 to stockholders of record September 23. Duluth Edison Electric Company; regular quarterly dividend of 1½ per cent on the preferred stock, payable October 1 to stock of record September 26. Providence Telephone Company; regular quarterly dividend of 2 per cent, payable October 1. American Telephone and Telegraph Company; regular quarterly dividend of 2 per cent, payable October 15 to stock of record September 30. Colorado Telephone Company; regular quarterly dividend of 1¾ per cent, payable October 15 to stock of record September 30. Bell Telephone Company of Canada; regular quarterly dividend of 2 per cent, payable October 15 to stock of record September 25. Canadian Westinghouse Company, Limited; quarterly dividend of 1½ per cent, payable October 1. General Electric Company; quarterly dividend of $2 per share, payable October 15. Butte Electric and Power Company; quarterly dividend of 1½ per cent, payable October 1. Massachusetts Lighting Companies; regular quarterly dividend of 1½ per cent, payable October 15. St. Joseph Railway, Heat, Light and Power Company; quarterly dividend of 1¼ per cent, payable October 1.

ELECTRICAL SECURITIES FOR THE WEEK ENDED SEPTEMBER 19.

New York:	*Closing.*
Allis-Chalmers common	10¼
Allis-Chalmers preferred	30½
Brooklyn Rapid Transit	49½
Consolidated Gas	143½
General Electric	139
Interborough-Metropolitan common	11
Interborough-Metropolitan preferred	31
Kings County Electric	123
Mackay Companies (Postal Telegraph and Cables) common	67
Mackay Companies (Postal Telegraph and Cables) preferred	67½
Manhattan Elevated	133
Metropolitan Street Railway	28
New York & New Jersey Telephone	115½
Western Union	59½
Westinghouse Manufacturing Company	71¼

Boston:	*Closing.*
American Telephone and Telegraph	127¼
Edison Electric Illuminating	230
Massachusetts Electric	48
New England Telephone	117½
Western Telephone and Telegraph preferred	75

Philadelphia:	*Closing.*
Electric Company of America	10
Electric Storage Battery common	35
Electric Storage Battery preferred	35
Philadelphia Electric	9¾
Philadelphia Rapid Transit	18¾
United Gas Improvement	85½

Chicago:	*Closing.*
Chicago Telephone	146
Commonwealth Edison	107
Metropolitan Elevated preferred	42
National Carbon common	67
National Carbon preferred	109

ELECTRIC RAILWAYS.

BURLINGAME, CAL.—H. W. Hagen, of San Mateo, has applied to the city council of this place for an electric railroad franchise to San Mateo beach.

ROCHESTER, N. Y.—The Rochester Railway and Light Company will reconstruct its storage battery plant at the station at the foot of Factory street at a cost of about $10,000.

MINEOLA, N. Y.—The board of supervisors has granted the New York & North Shore Traction Company the right to extend its trolley line from Mineola to Hicksville by way of Westbury.

SHEBOYGAN, WIS.—From the present progress of work on the Milwaukee and Fox River Valley Railroad it is expected that the line will be completed next spring. Grading operations will begin in a short time.

NEW YORK, N. Y.—The railway service of the Brooklyn Rapid Transit over the Williamsburg Bridge was opened on September 16 when Mayor McClellan drove a six-car "L" train from the Manhattan side to Brooklyn.

MERCERSBURG, PA.—It is stated that the Byrons, proprietors of the steam tanneries in Mercersburg and Williamsport, Md., are at the head of a company being formed to finance and build a trolley line connecting the two towns.

WEATHERFORD, TEX.—The survey for the Fort Worth, Weatherford & Mineral Wells interurban is completed to Millsap, eight miles from Mineral Wells, and the work of raising $250,000 subscription in the three cities has been begun.

DUBUQUE, IOWA—A gang of surveyors in the employ of the Clinton, Maquoketa and Dubuque Interurban Railroad Company is making surveys of the country between Dubuque and Maquoketa for the purpose of locating a route for proposed line.

DOYLESTOWN, PA.—Charles L. Baum and Samuel Crothers, Jr., have been appointed receivers for the Philadelphia, Bristol and Trenton Street Railway Company, which has defaulted in the payment of six months' interest on its $165,000 mortgage.

CHICAGO, ILL.—The Aurora, Elgin and Chicago Electric Railway will extend its line from Wheaton to Maple Park, Ill., where it will connect with its Clinton (Iowa) division, giving the railway company a direct line from Clinton, Iowa, to Chicago.

ROANOKE, VA.—J. W. Hancock, manager of the Roanoke Railway and Electric Company, announces that the contract for the company's new office building has been awarded to C. W. Hancock & Son, of Lynchburg. Work will be commenced immediately.

NEWARK, N. Y.—The village board has extended the franchise of the proposed Geneva, Phelps & Newark trolley line another year. On account of the recent business depression there was more delay than was expected in financing the road. It is stated that work will begin in the spring.

WALLA WALLA, WASH.—A franchise has been granted the Washington & Oregon Traction Company giving it the right to operate electric cars over the principal streets of the city for a period of twenty-five years. In consideration of this franchise the company agrees to pay the city $8,000.

CHEYENNE, WYO.—Work on the extension of the Cheyenne street railway system to Fort Russell, a distance of three miles, is to be begun at once, the War Department having authorized the railway company to use a right of way north of the main driveway connecting the city with the post.

ST. LOUIS, MO.—The Missouri Electric Railroad Company, a subsidiary of the United Railways Company, which recently took over the St. Charles & Western line, has filed its $1,000,000 bond mortgage to the Mercantile Trust Company as trustee in St. Louis. The bonds run for ten years at five per cent.

DES MOINES, IOWA—Articles of incorporation have been filed for the company proposing to build a railroad between Des Moines and Council Bluffs. It is capitalized at $30,000. The present officers are as follows: J. W. Russell, president; Frank M. Tompkins, vice-president; M. H. Miller, secretary; E. Lockwood, treasurer.

CONNELLSVILLE, PA.—The Manor Valley Street Railway Company has let the contract for the construction of a line from Irwin to Herminie to Ryan & Campbell, of Latrobe. Work will begin at once. The construction of the road alone will cost about $50,000. The Manor Valley Company is composed of Irwin and Manor capitalists.

IOWA CITY, IOWA—The city council has granted a franchise to Henry Negus, of this city, and I. J. Hamiel, of Tipton, for the construction of a street railway in Iowa City. Local capital is largely interested, and it is believed that the line will be constructed within two years. It is designed principally to serve the residents of the east and southeast portions of Iowa City.

COLUMBUS, OHIO—Stockholders of the Columbus Railway and Light Company at a meeting unanimously voted to ratify the lease of the properties of the Columbus Public Service Company, from the Columbus Light, Heat and Power Company, which was formed to take over the Public Service properties. The lease runs fifty years and includes all the franchises of the Public Service Company.

ST. LOUIS. MO.—Within two months surveys will be under way for the proposed electric railway to connect Mobile with Citronelle, Ala., thirty miles. Right of way has been secured. Over $500,000 will be spent. C. A. Elkins, of Louisville, Ky., and George S. Bressler, of Gulf Crest, Ala., are promoters of the project. The name of the line will be the Mobile & Gulf Interurban Electric.

LANSDOWNE, PA.—It is stated that the Philadelphia & West Chester Street Railway Company is negotiating for the purchase of the Chester & Darby division, and the Chester & Wilmington division of the Chester Traction Company, which belong to the Interstate Railways Company. It is said that the Philadelphia & West Chester Traction Company desires to extend its line to Wilmington.

ALBANY, N. Y.—Articles of incorporation have been filed in Albany by the promoters of the Greater New York Traction Company. The application for a charter sets forth that the company wants to build and operate an electric street railway in Fulton, Cortlandt and William streets and Maiden Lane, Manhattan Borough, connecting with the Brooklyn Bridge and ferries. The proposed rate of fare is three cents. The capital is $15,000, and the incorporators: C. F. Thum, Arthur G. Still, Joseph W. Spencer, Frank S. Burns, Charles M. Koop and others, of New York city.

YORK, PA.—It is stated that a new trolley line from York to Baltimore is to be built by York, Philadelphia and Maryland capitalists. The line has already been built from York to Hanover, and a survey will be made from that point. It is proposed that the cars connect with the Emory Grove line, which comes to this city, giving the people of York a route to Baltimore by trolley. It is said that a Philadelphia banking house will finance the scheme. Those interested are Captain W. H. Lanius and ex-Judge W. F. Bay Stewart, of York; H. W. Gitt and George Gitt, of Hanover; Dr. James H. Sherman, J. E. Mosenheimer, Jacob A. G. Frederick and Jacob N. Dehoff, of Carroll County.

DATES AHEAD.

American Institute of Mining Engineers. Annual meeting, Chattanooga, Tenn., October 1-3.

Illuminating Engineering Society. Annual convention, Philadelphia, Pa., October 5-6.

Empire State Gas and Electric Association. Annual meeting, New York city, October 7.

Kansas Gas, Water, Electric Light and Street Railway Association. Annual meeting, Pittsburg, Kan., October 8-9.

American Street and Interurban Railway Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Accountants' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Claim Agents' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Engineering Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Manufacturers' Association. Annual convention, Atlantic City, N. J., October 12-16.

Railway Signal Association. Annual meeting, Washington, D. C., October 13-15.

Order of the Rejuvenated Sons of Jove. Annual meeting, Buffalo, N. Y., October 15-16.

American Society of Municipal Improvements. Annual meeting, Atlantic City, N. J., October 20-23.

American Electrochemical Society. Fall meeting, New York city, October 30-31.

Association of Car-Lighting Engineers. First annual meeting, Chicago, Ill., November 18.

INDUSTRIAL ITEMS.

THE TUNGSTOLIER COMPANY, 520 Citizens' Building, Cleveland, Ohio, is distributing a leaflet containing several testimonials from satisfied users of the Tungstolier system of lighting, bearing particularly upon the saving, the illumination, and the life secured with this system.

THE METROPOLITAN ELECTRICAL SUPPLY COMPANY, Chicago, Ill., is introducing a new insulating paint made by Frank S. DeRonde Company, of New York city. Mr. DeRonde was long connected with the Standard Paint Company. The company is also sending out a metal polish, made by the same company. It is claimed that the two articles have superior merit.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has ready for distribution a new bargain list of motors. These motors are in packed St. Louis stock. They are second-hand motors only inasmuch as they have been in service. They have been cleaned up, refinished, repaired where necessary, and are sold at low prices with the same guarantee as is given on new machines.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has secured an order from the Kobe Electric Railway Company, of Kobe, Japan, for two 500-kilowatt, twenty-five-cycle, engine-type, three-phase alternators; two twenty-kilowatt, 125-volt marine-type exciters; one forty-kilowatt motor-generator set; four forty-kilowatt transformers; 100 GE-78 railway motors complete, and a complete switchboard equipment for the power-house.

THE NEW YORK INSULATED WIRE COMPANY, 114-118 Liberty street, New York city, has published price list No. 22, entitled "Rubber-Covered Wires of Quality." This list gives prices on rubber-covered wires on the various copper bases, from eleven cents to twenty-one cents, besides containing various tables which will be found of considerable service. The booklet will be sent upon request to any one who uses or deals in rubber-covered wires.

THE BLAKE SIGNAL AND MANUFACTURING COMPANY, 246 Summer street, Boston, Mass., is constantly in receipt of testimonials to the excellence of its soldering flux. The following is a sample testimonial which has recently been received: "Enclosed please find twenty-five cents in stamps, for which please mail me as much Blake tube flux as this amount will pay for. I have used the sample tube you mailed me and it certainly is all that is claimed for it, and then some."

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., has closed a contract with the Chicago City Railway Company to furnish and install in the Plymouth Court substation a storage battery complete with booster, switchboard and wiring, rated at 4,800 amperes for one hour, it being permissible to discharge the battery at rates up to 9,600 amperes in emergency service. The battery is to be operated on a 550-volt bus. It will be charged at times of light load and discharged, as occasion may require, on the peak loads.

THE NATIONAL BATTERY COMPANY, Buffalo, N. Y., announces that the receivership under which the company has been operating since last February was terminated on August 19. The claims against the National Battery Company have been settled, and the entire property has been restored to the stockholders. It is also stated that the full control of the reorganized company has been secured by the Cutler-Hammer Manufacturing Company, of Milwaukee, Wis., well known as the maker of battery-charging rheostats and other electrical controlling devices. The plant of the National Battery Company will remain at Buffalo, but the business will be conducted under new management and with ample capital.

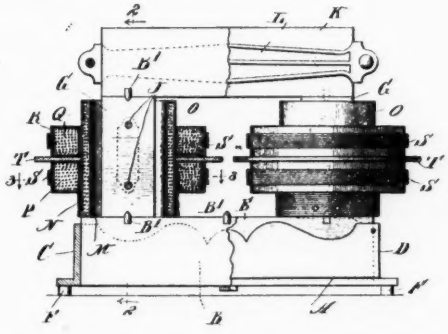
Record of Electrical Patents.

Week of September 15.

898,430. ELECTRICALLY CONDUCTIVE RAILWAY-RAIL JOINT OR CONNECTION. Bancroft G. Braine, New York, N. Y., assignor to the Rail Joint Company, New York, N. Y. Filed October 25, 1907. The railway is equipped with connecting plates contacting with the heads and base flanges.

898,473. RAILWAY SIGNAL. John Hoffer, Louisville, Ky. Filed January 14, 1908. Connections leading from the main switch to the signal operate an electric bell.

898,485. DEVICE TO PREVENT TROLLEY WHEELS FROM JUMPING. William O. Lane, Cleveland, Ohio. Filed December 20, 1907. The trolley pole is equipped with a forked bracket provided with a clamping plate.



898,529.—ELECTRICAL LABORATORY APPARATUS.

898,506. APPARATUS FOR THE PRODUCTION OF OZONE. John R. Quain, London, England, assignor of one-half to Edward Applegarth, London, England. Filed February 12, 1907. Means are provided for passing air through relatively narrow passages, the electrodes operating in vacuo.

898,509. ELECTRICAL-CIRCUIT PROTECTOR. Charles A. Rolfe, Adrian, Mich., assignor, by mesne assignments, to Rolfe Electric Company, Rochester, N. Y. Filed December 29, 1903. The contacts are normally under tension, and are held apart by a heat-concentrating device adapted to soften or melt the holding material.

898,529. ELECTRICAL LABORATORY APPARATUS. Chester H. Thordarson, Chicago, Ill. Filed April 17, 1905. A magnet-wound transformer for extremely high potentials.

898,540. ELECTRICAL FITTING. Edson B. Wilcox, Meriden, Ct. Filed May 29, 1908. An insulated electrical fitting.

898,544. TELEPHONE TRANSMITTER. Henry F. Albright, Elizabeth, N. J., assignor to Western Electric Company, Chicago, Ill. Filed October 28, 1907. The movable button is held in a bushing mounted in the diaphragm.

898,576. TELEPHONE SWITCH. Verne E. Green, Galva, Ill. Filed August 6, 1907. A common bus alternately connects a series of extension circuits.

898,578. ELECTRIC HEATER. Andrew J. Holmes, Tacoma, Wash. Filed May 10, 1906. An alternating-current coil heater.

898,607. ILLUMINATING APPARATUS. Jean Schmidt, Frankfort-on-the-Main, Germany. Filed May 8, 1907. A plurality of arcs is supported on translating members which have a common reciprocal movement.

898,619. TELEPHONE APPARATUS. Frank W. Wood, Newport News, Va., assignor to Charles Cory and John M. Cory, New York, N. Y. Filed April 17, 1907. A combination concentrically arranged mouthpiece and trumpet.

898,620. TELEPHONIC APPARATUS. Frank W. Wood, Newport News, Va., assignor to Charles Cory and John M. Cory, New York, N. Y. Filed April 5, 1907. A combination transmitter and receiver.

898,648. ELECTRIC CLOCK. Monnosuke Higuchi, New York, N. Y. Application filed November 3, 1903. Means are provided for rendering the alarm circuit inoperative.

898,649. ELECTRIC CLOCK. Monnosuke Higuchi, New York, N. Y. Filed November 3, 1903. Means are provided for selective ringing of the alarm.

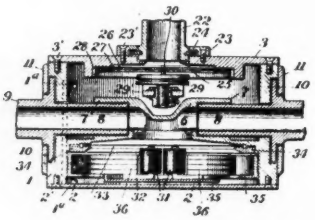
898,675. PASSENGER-RECORDING SYSTEM FOR TRAINS. Walter E. Parr, Sparta, Mo. Filed December 6, 1906. The system is designed to check the whole and half-fare passengers boarding the car.

898,686. ELECTRIC BELL. Tito Rosati, Florence, Italy, assignor of one-fourth to Ferdinand R. Sari and Bartolomeo G. Giuliana, Washington, D. C. Filed August 7, 1907. The bell is actuated by a high-potential circuit, and is put in operative condition by a low-potential circuit.

898,691. ELECTRIC-FURNACE PROCESS. George O. Seward and Franz von Kügelgen, Holcombs Rock, Va., assignors, by mesne assignments, to Electro Metallurgical Company, West Virginia. Filed February 21, 1906. New lengths of the electrode are successively fed to the charge without withdrawal of the electrode from the charge.

898,696. ELECTRIC LIGHT BULB CHANGER. Charles F. Southworth, Cambridge, Mass. Filed February 13, 1908. A combination of a rod and a cup having a continuous, elastic, annular rim.

898,698. FUSE BOX. John O. Stiners, Denver, Col. Filed October 26, 1906. A movable fuse carrier provided with pairs of contacts is mounted upon a contact plate.



898,620.—Telephonic Apparatus.

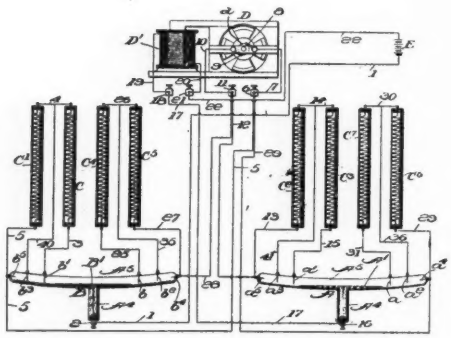
898,699. PORTABLE TELEPHONE APPARATUS. Frederick F. Strong, Boston, Mass. Filed April 3, 1905. A microphone arrangement with a flexible ear-piece.

898,715. INCANDESCENT LAMP. Frederick M. Bennett, New York, N. Y. Filed March 6, 1908. The filament is arranged to distribute the illumination in useful directions.

898,752. METAL FILAMENT FOR ELECTRIC INCANDESCENT LAMPS. Hans Kuzel, Baden, near Vienna, Austria-Hungary. Filed July 16, 1907. The stem is equipped with guide wires both at the end and at its middle position.

898,756. OUTLET BOX. George A. Lutz, New York, N. Y., assignor to American Circular Loom Company, Portland, Me. Filed January 5, 1907. The junction piece is provided with openings providing ringlike parts.

898,766. ELECTRIC SWITCH AND SYSTEM OF CONTROL. Joseph V. Mott, New York, N. Y. Filed February 2, 1907. A variable fluid resistance rheostat.



898,766.—Electric Switch and System of Control.

898,771. COMBINATION ELECTRIC-SERVICE CUTOUT AND METER PANEL. Henry E. McGowan and Edwin R. Ellsworth, New York, N. Y. Filed March 9, 1907. The measuring instrument and the cutout box are mounted on a single panel.

898,785. ELECTROLYTIC APPARATUS. Marcus Ruthenburg, Lockport, N. Y. Filed January 18, 1907. The outer tanks are sealed against the atmosphere and contain inner porous cups.

898,796. TELEPHONE SET. Sol S. Sonneborn, New York, N. Y. Filed October 1, 1907. The magnet receiver is mounted in the hollow stem of the desk set.

898,822. PLURAL LAMP SOCKET. Reuben B. Benjamin, Chicago, Ill., assignor to Benjamin Electric Manufacturing Company, Chicago, Ill. Filed February 23, 1907. A multiple socket equipped with a screw base.

898,823. PLURAL LAMP SOCKET. Reuben B. Benjamin, Chicago, Ill., assignor to Benjamin Electric Manufacturing Company, Chicago, Ill. Filed Feb. 27, 1907. The plug cluster has a central and an outer contact member.

898,824. PLURAL LAMP SOCKET. Reuben B. Benjamin, Chicago, Ill., assignor to Benjamin Electric Manufacturing Company, Chicago, Ill. Filed February 28, 1907. The plug is adapted to co-operate with a suitable socket, and carries a plurality of lamp-holding devices.

898,825. PLURAL LAMP SOCKET. Reuben B. Benjamin, Chicago, Ill., assignor to Benjamin Electric Manufacturing Company, Chicago, Ill. Filed March 1, 1907. The plural lamp socket is provided with a central contact and an outer contact adapted to co-operate with socket contacts.

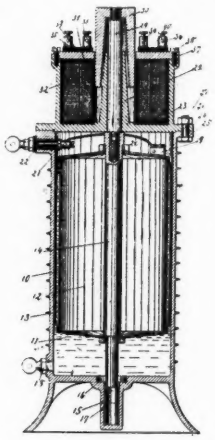
898,826. PLURAL LAMP SOCKET. Reuben B. Benjamin, Chicago, Ill., assignor to Benjamin Electric Manufacturing Company, Chicago, Ill. Filed March 1, 1907. A canopy cluster with a central contact and a side contact adapted to co-operate with a suitable socket.

898,847. APPARATUS FOR EXPLODING MINE CHARGES. Charles I. Dodson, Pittsburg, Kan. Filed April 6, 1907. The clock is provided with means for automatically operating a switch.

898,848. MEANS FOR EXPLODING BLAST CHARGES. Charles I. Dodson, Pittsburg, Kan. Filed February 14, 1908. A latch is provided for holding the actuating means in inactive position.

898,862. ELECTRIC RAILROAD SIGNAL. Timothy C. Fogarty, Frank W. Brock and Frank A. Bowdle, Chatham, Ill. Filed January 13, 1908. A rigid device is operated by the movement of the car, the movement of the semaphore closing a magnetic circuit.

898,888. SPARK-GAP. Isaac S. Hirsch, New York, N. Y., assignor to E. B. Meyrowitz, New York, N. Y. Filed July 18, 1907. Means are provided for varying the spark-gap.



898,987.—Rheostat.

898,915. ELECTRIC SIGNALING OR TELEGRAPH APPARATUS FOR USE ON VEHICLES. Robert B. North, Soho, England. Filed June 4, 1907. A plurality of plates is provided, each contact plate having a separate designation or order.

898,921. INSULATOR. Thomas F. Purves, Wandsworth, London, and John Sinnott, East Finchley, London, England. Filed February 3, 1908. The insulator is provided with a leading-in cavity, and the chamber may be sealed with insulating material.

898,949. ADVERTISING DEVICE. Charles T. Wilks, Woodlawn, Ala. Filed May 21, 1908. A combination of an electric lamp, a lamp circuit, and a series of rollers.

898,968. SIGNAL. David H. Coker, Piedmont, and Whitfield A. Scarbrough, Choccolocco, Ala. Filed January 23, 1907. The circuit is opened and closed by the operation of the railroad switch.

898,979. PROCESS OF ELECTRICALLY CONNECTING FILAMENTS TO SUPPLY WIRES IN ELECTRIC GLOW LAMPS. Hans Kuzel, Baden, near Vienna, Austria-Hungary. Application filed January 19, 1906. Finely powdered metals are melted to form carbides at high temperatures.

898,987. RHEOSTAT. Heinrich Poth, Brooklyn, N. Y. Filed December 8, 1905. An electromagnet is adapted to vary the active amount of the resistance medium in circuit.

898,992. ALARM. Jay A. Robinson, Denver, Col. Filed October 26, 1907. The receiver hook is held in its lowest position by an electromagnet.

899,012. ELECTRIC CLOCK. Monnosuke Higuchi, New York, N. Y. Application filed November 3, 1903. The hour and minute strikes are actuated by electromagnetic means.